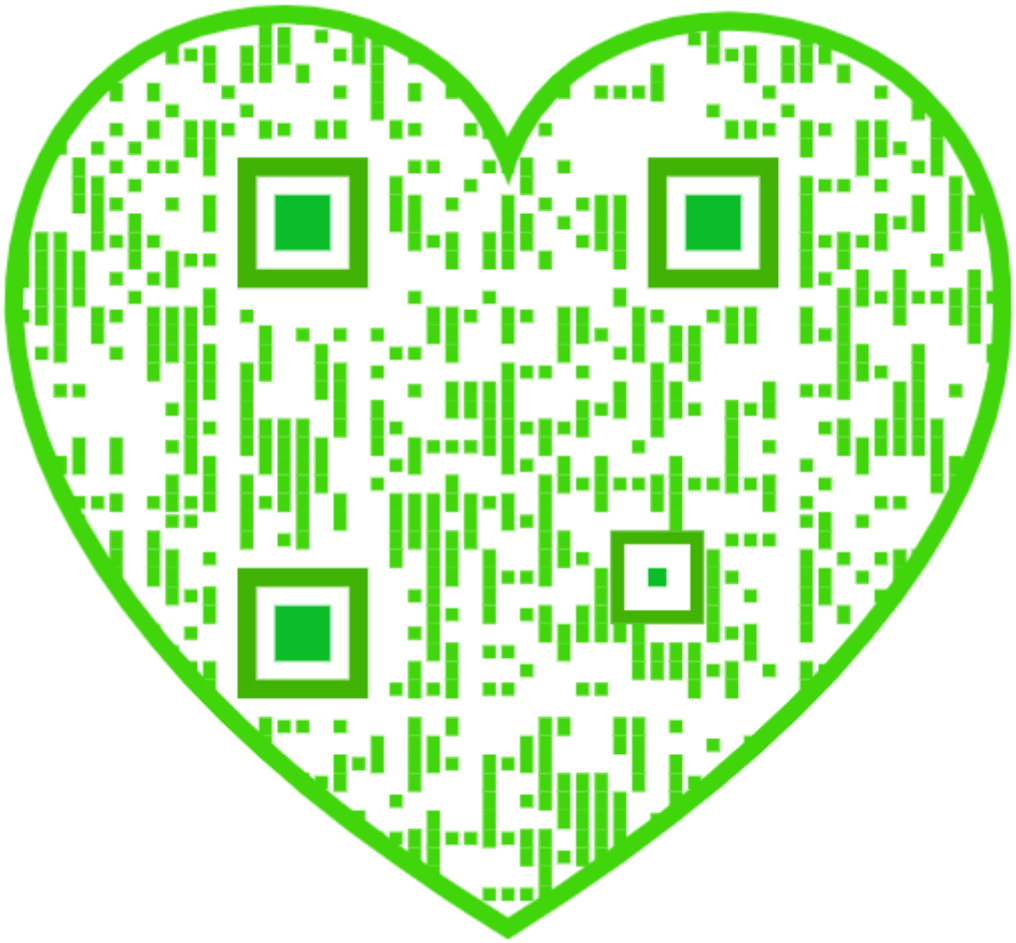

DEPARTMENT OF COMMERCE
BUREAU OF FOREIGN AND DOMESTIC COMMERCE
A. H. BALDWIN, Chief

SPECIAL AGENTS SERIES—No. 74

LINEN, JUTE, AND HEMP INDUSTRIES IN THE UNITED KINGDOM

WITH NOTES ON THE GROWING AND MANUFACTURE OF JUTE IN INDIA

By

W. A. GRAHAM CLARK
Commercial Agent of the Department of Commerce

WASHINGTON
GOVERNMENT PRINTING OFFICE
1913

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LETTER OF SUBMITTAL.

DEPARTMENT OF COMMERCE,
BUREAU OF FOREIGN AND DOMESTIC COMMERCE,
Washington, September 25, 1913.

SIR: I have the honor to submit herewith a report by Commercial Agent W. A. Graham Clark on the linen, jute, and hemp industries of the United Kingdom, with supplementary data as to the growing and manufacture of jute in India. As linen manufacturing centers largely in Ireland and jute manufacturing in Scotland, special attention is given to these industries in their respective fields. Detailed information is presented as to processes of manufacture, cost of production, wages and conditions of employment, cost of constructing and operating factories, commercial usages, and foreign trade.

Respectfully,

A. H. BALDWIN,
Chief of Bureau.

To Hon. WILLIAM C. REDFIELD,
Secretary of Commerce.

LINEN, JUTE, AND HEMP INDUSTRIES IN THE UNITED KINGDOM.

INTRODUCTION.

Flax, hemp, and jute are so-called bast fibers, which are found in the skin of the plant stems producing them and which are freed from the inner woody core and the surrounding pulp by retting. They differ in this from the hard fibers, such as abaca, henequen, sisal, aloe fiber, and New Zealand hemp, which are found in the leaves of the plants producing them, from which they can be separated only by scraping, or decortication. Being similar in their plant nature, flax, hemp, and jute are frequently grouped in statistics, and their manufacture forms the third most important textile industry of the United Kingdom, being exceeded by cotton and wool manufacturing and being followed by silk, which is a poor fourth. Flax is mainly a clothing material, jute is the premier wrapping and sacking material of the world, while hemp is primarily a cordage material.

POSITION OF BRITISH TEXTILE INDUSTRIES.

In the United Kingdom Manchester is the center of cotton manufacturing, Bradford of wool, Belfast of linen and hemp, Dundee of jute, and Macclesfield of silk. From the beginning of the machine manufacture of cotton the English have led in this industry, and in spite of increasing competition they still have a great lead in spindles and looms and in value of output, though surpassed by the United States in the amount of raw material worked. Until the middle of the eighteenth century wool was England's foremost textile industry, and, though it has now been displaced by cotton, England still leads in the manufacture and export of woolen goods, with the United States and Germany yearly increasing their competition. In jute manufacture the United Kingdom led for a long while, but it is now greatly distanced by India and has taken second place. In flax manufacture the United Kingdom still maintains a great lead over all competitors, but in the manufacture of soft hemp it is distanced by Russia. In silk the United Kingdom has not been very successful and the industry has declined greatly from its former position. Although flax and wool are produced on a commercial basis in the United Kingdom, the bulk of these raw materials is obtained from abroad, while the cotton, jute, hemp, silk, and lesser used fibers are obtained entirely from other countries.

Flax, hemp, wool, and silk are ancient fibers, while cotton and jute are of very modern use in the world's markets. Cotton did not attain great importance until the invention of the cotton gin in 1793, while jute manufacture on a commercial scale may be said to have started at Dundee about 1838. To-day, however, cotton is the

premier fiber of the world, and more pounds of jute are manufactured than of any other fiber except cotton.

SOURCES OF RAW MATERIALS.

Flax is the oldest of all vegetable fibers of which we have record as being applied to the use of mankind, and at the dawn of recorded history we find the Egyptians famous for its manufacture. To-day Ireland is most noted for its manufacture, and the linen requirements of the land of the Pharaohs and of other lands beyond the seas are supplied mainly from Belfast. The center of the world's manufacture is the Province of Ulster, of which Belfast is the capital and chief city. Other important flax-manufacturing countries are France, Russia, Germany, and Belgium, but the United Kingdom contains about a third of the flax spindles of the world, of which the total may be estimated at something over 3,000,000. The York Street Flax Spinning Co. (Ltd.), of Belfast, who have some 63,000 spindles and 1,000 looms, and who are spinners, weavers, merchants, and bleachers, claim to be the world's largest flax-manufacturing concern. The bulk of the world's flax supply is raised in Russia, while smaller quantities are produced in Austria-Hungary, Italy, Germany, France, Belgium, Ireland, and the Netherlands.

Hemp is raised to some extent in China, Japan, India, and other sections, but it is typically a European product. Russia produces the bulk of the soft hemp, substantial amounts also being raised in Italy, Austria, and France. Soft hemp is manufactured mainly in ropeworks, which also use the hard fibers, so that it is difficult to obtain world statistics that can be considered accurate. The Belfast Ropeworks Co. (Ltd.), of Belfast, claims to be the largest concern engaged in its manufacture.

Jute is almost a monopoly of the northeast section of India and is the world's cheapest fiber. The center of manufacture is around Calcutta, in the Province of Bengal, but Dundee leads in the production of the higher-grade articles.

OPERATIVES IN BRITISH TEXTILE TRADES.

The operatives employed in the various textile industries of the United Kingdom, according to Board of Trade figures, were as follows in 1907, the latest year for which statistics are available:

Industries.	Male.		Female.		Total.
	Number.	Per cent.	Number.	Per cent.	
Cotton	217,742	37.75	359,078	62.25	576,820
Wool and shoddy	108,838	41.67	152,354	58.33	261,192
Flax	29,756	29.62	70,719	70.38	100,475
Hosiery	9,609	24.04	30,362	75.96	39,971
Jute	12,366	31.08	27,419	68.92	39,785
Silk	8,776	30.40	20,097	69.60	28,873
Lace	12,843	61.08	8,181	38.92	21,024
Hemp	3,788	34.81	7,095	65.19	10,883
Other textiles	3,642	44.42	4,558	55.58	8,200
Total	407,360	37.47	679,863	62.53	1,087,223

Next to the hosiery trade, the flax, silk, jute, and hemp trades contained the largest percentage of female labor.

YARN PRODUCTION AND TRADE IN 1907.

As the 1907 census of production was the first taken in the United Kingdom and the final results were largely the result of estimates to avoid duplications, etc., the figures obtained are more valuable as an indication than as an accurate enumeration. They serve, however, to throw considerable light on the status of the various industries. In the figures finally published, the bast fiber industries—those utilizing flax, hemp, and jute—are grouped more or less.

The net output per operative was found to be £61 ($297) per year for the flax, hemp, and jute industries as a whole, and £75 ($365) for the rope, twine, and net trades. This compares with an output per operative per year of £79 ($384) for the cotton industry and of £70 ($340) for the wool industry.

The total production of yarn in the jute, hemp, and linen industries of the United Kingdom, including both that woven and that sold, the total exports, and the total net imports (imports less reexports) were as follows in 1907:

Yarns.	Production.		Exports.		Net imports.	
	Pounds.	Value.	Pounds.	Value.	Pounds.	Value.
Jute	485,000,000	$31,632,250	67,519,000	$5,995,530	5,954,000	$502,150
Linen	155,000,000	38,771,406	16,442,000	6,049,060	20,647,000	3,825,070
Hemp	65,000,000	7,299,750	[1]	[1]	10,140,000	973,300

[1] Not stated.

Less than one-seventh of the quantity of jute yarns manufactured in the United Kingdom was exported in the form of yarn, and less than one-ninth of the linen yarns.

PIECE-GOODS PRODUCTION AND TRADE.

The British production, exports, and net imports of piece goods in 1907 were as follows, the figures including both pure and mixed goods:

Articles.	Production.		Exports.		Net imports.
	Yards.	Value.	Yards.	Value.	
Jute	229,203,000 [1] 32,061,000 [2] 130,368,000	$28,337,630	179,377,000	$13,378,008	$3,820,203
Linen:					
Plain	269,268,000	[3] 30,483,756	166,365,000	23,524,661	3,815,336
Checked, printed, etc	70,521,000	[3] 12,463,107	14,264,000	2,267,789	
Sailcloth and canvas	23,409,000	[3] 5,703,538	4,370,000	1,104,696	

[1] Square yards.
[2] Pounds.
[3] The sum of $1,970,933, the value added by bleaching, etc., should be divided between these items; piece goods valued at about $2,822,570, made into articles of clothing, etc., by weaving firms, are also excluded.

About half of the quantity of jute piece goods was exported in the cloth. Of the three classes of linen piece goods, about 62 per cent of the plain, bleached, and unbleached piece goods was exported and about 20 per cent of the checked, printed, dyed, damask, and diaper piece goods, the figures in both cases being exclusive of the piece goods made into articles of clothing, etc., by weaving firms. About 19 per cent of the sailcloth and canvas was exported.

ESTIMATE OF TOTAL PRODUCTION.

As a considerable quantity of yarn made by spinners and sold to weavers was included by both classes of manufacturers in their output, once as yarn and again as piece goods, and, further, as the exact quantity of yarn sold to rope and net makers was not known, it was not possible to state precisely the value of the jute, hemp, and linen production as a whole. The census estimated, however, on the basis of the following particulars for 1907:

	Value.
Jute yarn exported	$5,995,530
Linen yarn exported	6,049,060
Jute piece goods made	28,337,630
Linen piece goods made	53,443,903
Cordage, rope, twine, etc., made (including hemp yarn spun in Ireland)	7,372,748
Other goods of jute, linen, and hemp made, including waste and flax and tow dressed	3,572,011
Value added by making up linen goods	3,163,225

After making allowance for the value of the linen thread and yarn not sold to weaving firms, etc., the total value of the output of the jute, hemp, and linen spinning, doubling, and weaving trades (including goods as bleached, dyed, etc.) was given as approximately £24,000,000 ($116,796,000), exclusive of work done by rope and net makers. If the cordage made in the regular jute, hemp, and linen trades be excluded and its value taken only as that of yarns, the value of the output of the spinning and weaving branches of these trades, together with the value of goods made up in weaving factories, may be estimated as approximately £23,000,000 ($111,929,500).

The $111,929,500 represents the value of the output of the British jute, hemp, and linen industries in 1907, but in addition there were products from rope, twine, and net factories to the value of $17,947,652. The total value of rope, twine, and net in the United Kingdom was $25,344,700, if there be included $7,397,048 that represents the value of such goods made by factories whose main business is along other lines. In quantity, the total output was 236,656,000 pounds.

The excess of the value of the gross output over the cost of the materials and of some work done by outside firms—that is, the value added to the material by reason of the work done in manufacturing—amounted in the jute, hemp, and linen trades, in 1907, to $46,018,158, and in the rope, twine, and net trades to $5,216,888. In each case these figures represent the amount spent during the year for labor and general factory expenses, plus the profit.

TRADE IN RAW MATERIALS.

In considering the present status of the bast fiber industry in the United Kingdom it is of interest to ascertain the amount of raw materials they use as compared with other British textile industries. The imports and exports of raw materials for the calendar year 1912 given below are from British statistics. These statistics list rags, tow, waste, silk, etc., under the head of raw materials, and though cotton waste is given under articles partly or wholly manufactured, I have included it here as a raw material, which it is, as much as rags or waste silk.

Articles.	Imports.		Exports.	
	Pounds.	Value.	Pounds.	Value.
Raw cotton	2,805,817,800	$390,482,899	323,802,100	$51,522,122
Cotton waste	40,065,608	2,628,898	102,938,163	6,923,900
Total	2,845,883,408	393,111,797	426,740,263	58,446,022
Sheep's wool	806,855,687	161,738,200	384,809,529	81,301,808
Alpaca, etc	3,639,175	860,407	266,475	71,854
Camel's hair	8,417,493	1,711,675	1,865,621	345,667
Mohair	35,731,188	8,319,228	1,005,774	318,503
Rags, pulled	2,901,798	200,918	13,556,749	1,920,009
Rags, unpulled	111,699,840	4,710,811	8,630,720	970,239
Wool noils, etc			19,567,500	5,955,365
Wool waste	2,929,630	416,047	12,211,909	3,181,533
Total	972,174,811	177,957,286	441,914,277	92,064,978
Flax	195,054,720	21,162,438	19,747,840	2,707,910
Flax tow	42,228,480	2,648,101	931,840	68,185
Hemp	323,946,560	17,980,126	120,711,360	6,336,864
Hemp tow	12,662,720	520,808	777,280	34,786
Jute	862,364,160	40,597,175	314,487,040	14,953,523
Similar fibers	13,478,080	461,991	3,295,040	141,104
Total	1,449,734,720	83,370,639	459,950,400	24,242,372
Raw silk	1,199,448	3,354,736	130,821	353,444
Silk waste and noils	8,524,992	3,684,948	2,096,304	611,223
Total	9,724,440	7,039,684	2,227,125	964,667
Grand total	5,277,517,379	661,479,406	1,330,832,065	175,718,039

The net imports of raw materials (that is, the imports less the exports) for 1912, by grand classes, were as follows: Cotton, 2,419,143,145 pounds, valued at $334,665,775; wool and hair, 530,260,534 pounds, valued at $84,892,308; flax, hemp, and jute, 989,784,320 pounds, valued at $59,128,267; silk, 7,497,315 pounds, valued at $6,075,017; total, 3,946,685,314 pounds, valued at $484,761,367.

The flax, hemp, and jute industries rank second in quantity of materials used and third in value. The value of the textile materials imported into the United Kingdom in 1912, not considering rags, waste, tow, etc., was for silk, $2.797 a pound; sheep's wool, 20.046 cents; raw cotton, 13.917 cents; flax, 10.85 cents; hemp, 5.55 cents; and jute, 4.708 cents. Jute was the cheapest fiber imported and silk the dearest. Raw cotton averaged higher in value than flax.

WAGES AND COMPARATIVE COST OF PRODUCTION.

The linen industry pays poorer wages than any other textile industry of the United Kingdom. The latest figures available are those for 1906, which showed that full-time workers in the cotton industry averaged 19s. 7d. ($4.77) a week; in the woolen and worsted industry 15s. 9d. ($3.83); in the jute industry, 14s. 3d. ($3.47), and in the flax industry only 12s. ($2.92). It is estimated that the average wages in the linen industry have advanced by about 6d. (12 cents) since that time, but even this average wage of $3.04 a week still leaves the linen workers the lowest paid of all British textile operatives.

Flax is as cheap as or cheaper than cotton, wages in the linen industry average less than two-thirds of those paid in the cotton industry, and yet finished goods made from flax average much higher in price than finished cotton goods. Manufacturers state that this is due to the fact that flax is a much more difficult fiber to manufacture than cotton, that it takes many more operatives and a much longer time to obtain the same output, that the first cost per spindle or per loom is much greater, and that bleaching and dyeing, owing to the hard and impermeable nature of the flax fiber, are much more elaborate and costly operations.

Cotton is linen's most formidable competitor, and its growing production and the increasing skill with which it is manufactured (making it in many cases difficult to distinguish it from linen) tend to prevent expansion in the manufacture of the older and more durable fabric. Owing to the great development of machinery in the cotton industry, cotton, though one of the shortest of fibers, is the most easily manufactured. A cotton mill using mule spindles can be erected and completely equipped in the United Kingdom for about 27s. 6d. ($6.69) per spindle, and a cotton ring-spinning mill complete for about 32s. 6d. ($7.91), whereas a flax-spinning mill using flyer spinning would cost about £7 ($34.07) per spindle. A flax-spinning mill requires three times as many operatives as a cotton-spinning mill of the same size, yet has a smaller production. A cotton weave shed for medium-grade cotton goods can be erected and equipped in the United Kingdom complete for about £36 ($175.19) per loom, whereas a linen weave shed making medium-grade linens costs about £45 ($218.99) per loom.

The difference in the first cost of spinning mills for the two industries is much greater than in the first cost of ordinary weave sheds, for in preparing and spinning flax the hard, slippery, and inelastic nature of the fiber necessitates much more expensive machinery. The great variations in the flax fibers, even in those from the same field, require elaborate and costly hackling and sorting, in which about 50 per cent of the fiber becomes tow of comparatively low value, raising the cost of dressed flax fully 50 per cent above that of new flax. Cotton, on the other hand, is very uniform in quality and is cheaply carded with much less loss in weight. The turn-off of a cotton spindle is much greater than that of a flax spindle and much larger bobbins or quills are permissible, which makes succeeding operations cost less. Cotton is more elastic than flax, hence more easily woven, and looms can be operated at a higher speed. In bleaching, cotton is finished more quickly and with less loss of weight and less risk of damage.

Cotton cloth can be bleached in a day or two, while linen takes about three weeks, and even longer. Flax fiber is able to withstand such formidable competition only by reason of its inherent beauty, strength, and durability, which enable it to endure repeated handling and washings with less loss of its sheen and hard surface and without napping.

SCOPE OF REPORT.

In the pages following the methods of manufacture and the present status of the fine linen trade of Ireland and the coarse linen trade of Scotland are discussed. Little reference is made to the English linen trade, as it is now a very small proportion of the total and as the trade of Barnsley in Yorkshire, the only surviving English center of any importance, is the manufacture of coarse goods similar to those made in Scotland. The study of the jute trade practically confines itself to the study of Dundee, as only a small amount is manufactured elsewhere in the United Kingdom. The hemp industry is not so localized and the ropeworks are scattered, most of them being located at the seaports of the three countries.

LINEN INDUSTRY IN IRELAND.

Irish linens are world-renowned, and in the manufacture of flax into linens Ireland leads all countries in both quality and quantity. The industry centers in the Province of Ulster, in North Ireland, and Ulster and its capital, Belfast, hold the same position in the world's linen trade as Lancashire and Manchester do in the cotton trade. Of some 3,000,000 spindles in the world working on flax, Ireland contains nearly a third.

Flax manufacturing, the staple industry of Ireland to-day, is its only surviving textile industry of importance. An extensive silk-weaving trade, founded by the Huguenots, existed at one time, but it suffered so much from strikes at home and increasing competition abroad that it has now almost disappeared. A large and flourishing woolen industry formerly existed in the south of Ireland, but its competition was so troublesome to the English trade that Parliament was induced to curtail its growth by heavy duties on the exportation of Irish woolens, and it was practically wiped out. As compensation, opportunities were afforded the Irish to prosecute their flax industry and bounties were voted for propagating and improving the manufacture of linen. This governmental assistance, which was given mainly in the form of bounty to exporters, was continued from 1711 to 1827, and amounted at times to over $100,000 a year.

EARLY DAYS OF INDUSTRY.

The manufacture of linen by hand seems to have flourished at a very early period in Ulster, and the cultivation of flax is thought to have been introduced by the Norman settlers who occupied Ireland in the thirteenth century. The cloth produced was coarse and very narrow, and it was not until the advent of the Huguenot refugees of 1685, after the revocation of the Edict of Nantes, and their introduction of the spinning wheel and other improved methods, that the industry began to be of importance. In 1720 Ireland exported 240,000 yards of linen, valued at about £100,000 ($487,000); by 1800 exports had grown to 25,041,517 yards, and by 1821 to 43,507,928 yards. All of this was both spun and woven by hand.

Flax-spinning machinery was invented in 1787 by John Kendrew and Thomas Porthouse, at Darlington, England. The first frames were driven by water power, but the newly discovered steam power was shortly afterward utilized. England and Scotland were not slow to take advantage of the new and improved method of spinning, but it was not until some 40 years afterwards, in 1828, that the first steam-driven flax-spinning mill in Ireland was erected at Belfast. The first spinning machinery invented by the English had been on the dry-spinning principle suitable only for coarse yarns, and it was not until superior yarns, made on the wet-spinning principle discov-

ered in 1825, began to come into Ireland and displace hand-spun yarns that the Irish found it necessary to adopt machine manufacture.

The first mill started in Ireland used wet spinning, and this system is almost universal in Ireland to-day. The Irish started power manufacture late, but as they profited by the earlier trials of their competitors the industry grew more rapidly. In the years of the great potato famine there was much emigration and this and the panic of 1847 affected the industry adversely, but about 1850 the industry again began to grow rapidly. All this time weaving had been done on hand looms and although power weaving started with 88 looms in 1850, it was many years before power looms outnumbered hand looms, and there are many of the latter running to this day.

EFFECT OF AMERICAN CIVIL WAR.

The American Civil War, which caused the world to turn to flax and other fibers as a substitute for cotton, led to an enormous expansion of the linen trade, and in the linen, as well as in the jute and wool industries, the figures reached during that period still mark the high tide of British exports. For instance, in 1864 the export of British-made linen yarn was 40,177,150 pounds, valued at $14,560,417, while in 1912 it was only 16,671,100 pounds, valued at $6,173,102. For fabrics the record year was 1866 when the value of the exports of linen manufactures of all kinds (except yarns) from the United Kingdom reached $46,602,796, which compares with $40,955,943 for 1912. Not only in value but in weight and yardage the war-period figures still hold the record. For instance, in piece linens 213,139,700 yards were exported in 1912, in contrast with the 255,632,385 yards shipped in 1866.

TREND OF INDUSTRY IN RECENT YEARS.

After the flush period caused by the American Civil War and the Franco-Prussian War there followed a prolonged period of depression, and the history of the trade since has been rather a checkered one. The number of Irish flax spindles, for instance, climbed from 250,000 in 1841 and 326,000 in 1850 to 924,817 in 1875, dropped to 827,451 in 1890, rose to 869,056 in 1897, dropped to 830,934 in 1903, and increased to 945,962 in 1911 and 951,362 in 1912. Since 1875, 17 mills containing 175,603 spindles have been dismantled, and it was not until 1909 that the industry once again counted as many flax spindles as it had in 1875. The new spindles installed in the last 30 years are for spinning fine counts and replaced coarse spindles, the production of which became unprofitable owing to the imports of coarse yarns from Belgium. These fine spindles run at a slower speed and the output in yards or in pounds of the spindles added since 1876 is less than that of the somewhat smaller number of coarse spindles discarded.

There have been periods of acute depression but also periods of equally acute booms. The greatest boom since Civil War times started in the early part of 1905 and lasted until the latter part of 1907. During this period Irish spinners made enormous profits. One

yarn spinner in speaking of this boom said that in 1907 on a capitalization of £60,000 he had cleared £40,000. The demand was such that he was overwhelmed with orders and buyers were not discouraged even when he asked what he regarded as prohibitive prices. The weavers also made great profits for two years, but prices were then forced up too high for buyers in outside markets and the final result was a period of short time for both spinning and weaving. This movement cleared off all accumulations of stock and placed the trade upon a thoroughly sound and independent basis, and at the present time the Irish linen trade seems to be making good profits.

CONDITION OF INDUSTRY AS REVEALED BY PRICES.

The disturbances to which flax spinning has been exposed are reflected more or less in the prices, which can be illustrated by quoting the price at Belfast (per bundle of 60,000 yards) of one standard number of line and of tow yarns at various dates:

Dates.	80s line weft.		25s tow weft.	
	English currency.	American currency.	English currency.	American currency.
	s. *d.*		*s.* *d.*	
December, 1860	4 3	$1.034	6 3	$1.521
August, 1864	6 7½	1.612	10 4½	2.524
December, 1865	6 1½	1.49	8	1.947
December, 1868	5 3	1.278	6 10½	1.673
September, 1870	3 4½	.821	5 9	1.399
December, 1870	3 6	.852	5 9	1.399
December, 1871	5 1½	1.247	6 9	1.643
December, 1875	4 6	1.095	6 9	1.643
December, 1880	4	.973	5 6	1.338
December, 1885	3 4½	.821	5 1½	1.247
December, 1890	3 7½	.882	4 5½	1.085
December, 1894	2 10½	.699	4 4½	1.064
December, 1895	3	.73	4 9	1.156
December, 1897	2 10½	.699	4 3	1.034
December, 1900	4	.973	5 3	1.278
December, 1905	4 6	1.095	6 3	1.521
December, 1910	4 9	1.156	6	1.46
December, 1911	4 6	1.095	5 10½	1.429
December, 1912	4 10½	1.186	7 1½	1.734

The first three quotations show the fluctuations from the beginning to the close of the Civil War. The quotation for September, 1870, marked the opening of the Franco-Prussian War, and that for December, 1871, the market after the war. The quotations for 1894, 1895, and 1897 show the severe depression existing during those years.

ADVANTAGES ENJOYED BY IRELAND.

In England and Scotland the linen industry has gradually declined, now being almost extinct in the former country. In Ireland the industry, in spite of many ups and downs, has increased, at least in weaving and finishing, to an extent that more than compensates for the decrease in the other two countries. The Irish manufacture of linen by hand was for a long time fostered with public money, and when this was withdrawn the industry promptly adopted the improved machinery and methods laboriously worked out by rivals. In

both England and Scotland the flax manufacturers have had to meet the competition offered by the rapid increase of other textile industries, which not only drew away operatives by higher wages but also in many cases took the manufacturers themselves; in fact, at Dundee most of the flax manufacturers have become jute manufacturers.

In Ireland flax manufacturing is practically the only textile industry, and as other industries, such as shipbuilding, require principally men, the flax mills have scarcely any competition as regards labor, most of which is female. The Irish linen industry can obtain labor at a lower average cost than any other British textile industry, not even excepting the jute industry of Dundee. The Irish industry is also greatly favored by the climate. Ireland is noted for its rain and fog, and the climate is equable and mild practically the year round. Flax is a rather difficult fiber to work, and Irish weather is an advantage, especially in the manufacture of fine yarns; but that a moist climate is not an absolute necessity for ordinary counts is shown by the success of mills on the Continent, where the climate is not different from that in the United States. The Irish excel in bleaching, and though they are now close pushed by competition from some modern French bleaching greens, Ireland has the advantage of a moist and equable climate that permits "grassing" operations through practically the whole year. Favorable climatic conditions and cheap, unorganized labor are the two chief factors that have led to the concentration of the British linen industry in the north of Ireland.

INCREASE IN WEAVING CAPACITY OF MILLS.

Since the flush times of the war period there has been a steady, if slow, increase in the weaving capacity of the mills, while the spinning capacity has fluctuated greatly, and in 1912 was not much larger than in 1875. In 1876 there were 924,817 spindles and 20,152 looms, while in 1912 there were 951,362 spindles and 36,942 looms. The failure of spinning to keep pace with weaving has led to increased imports of foreign yarns; or, to put it more correctly, the pressure of cheaper foreign yarns has retarded the development of Irish spinning.

IMPORTS AND EXPORTS OF YARN.

Though fluctuating greatly from year to year, there seems to be little increase in the export of linen yarns, while there is a growing import of foreign yarns. In 1880 exports were 16,477,500 pounds and imports 5,958,731 pounds, but in 1888 the imports overtook the exports and have increased until in 1912 the United Kingdom imported twice as many pounds of linen yarn as it exported. The figures for recent years are as follows:

Years.	Imports.		Exports.	
	Pounds.	Value.	Pounds.	Value.
1900	25,479,150	$4,454,994	16,347,100	$4,546,289
1905	21,787,642	3,740,823	14,694,300	4,514,248
1910	28,801,612	5,117,169	18,548,900	5,824,947
1911	28,976,012	5,331,981	18,012,800	5,938,634
1912	39,474,701	7,822,339	17,685,800	6,175,788

The linen yarns exported are mainly the finer and therefore higher-priced counts, while the imports are chiefly the coarser counts that Belgium and some other sections of the Continent can make more cheaply than the Irish. For 1912 the value of the yarns exported averaged 34.919 cents a pound, and of those imported 19.816 cents.

Of the 28,801,612 pounds of linen yarn imported into the United Kingdom in 1910, 11,130,745 pounds entered at the Irish port of Belfast, 11,260,918 pounds at the Scottish port of Leith, and 3,984,144 pounds at the English port of Goole, the small remainder coming in at other points. In proportion to its looms Scotland has few spindles, and imports about as much foreign yarn as Ireland; in addition it uses some Irish yarn.

Of the linen yarn imported into the United Kingdom over half is supplied by Belgium, with substantial amounts from France and smaller amounts from Germany, Russia, and other countries. The yarn exports are taken in largest quantity by Germany, which is followed by the United States and Belgium, and then the Netherlands, Egypt, Spain, and Portugal. British-made linen yarn shipped to the United States in the calendar years 1910, 1911, and 1912 amounted to 2,149,800, 2,271,200, and 2,506,500 pounds, respectively, with corresponding valuations of $562,645, $614,853, and $624,815.

In 1912 the amount of linen yarn shipped from the United Kingdom was almost the same as in 1840, in which year there were exported 17,733,575 pounds, valued at $4,004,526, while in 1912 the exports were 17,685,800 pounds, valued at $6,175,788. While the amount is practically the same, the value in 1912 was over 50 per cent greater. The average value of the linen yarn exported in 1840 was 22.582 cents a pound as compared with 34.919 cents in 1912.

EXPORT TRADE IN THREAD, PIECE GOODS, AND OTHER MANUFACTURES.

Aside from yarn, the exports are divided into piece linens, thread, and linen goods unenumerated. Of the piece linens exported in 1912, 191,910,600 yards, valued at $26,213,038, were classed as plain, unbleached, and bleached; 17,179,300 yards, valued at $2,443,961, as checked, printed, or dyed, and damask, and diaper; and 3,995,500 yards, valued at $1,128,541, as sailcloth. The great bulk of the exports is plain linen, mainly bleached. The exports of piece linens and also of linen goods unenumerated (mainly made-up articles, especially embroidered goods) seem to be on the increase, but though thread exports have recovered from the slump experienced about 1900 there does not seem to be much prospect of any increase in this line. The exports in recent years have been as follows:

Years.	Piece linens.		Linen thread.		Unenumerated manufactures.	Total manufactures.
	Yards.	Value.	Pounds.	Value.		
1900	154,708,200	$18,723,884	1,838,100	$1,154,110	$5,527,492	$25,405,486
1905	183,445,900	23,562,955	2,261,900	1,276,950	6,019,622	30,859,527
1910	220,568,000	29,760,662	2,738,900	1,665,355	8,871,980	40,297,997
1911	193,829,200	27,456,005	2,597,400	1,652,396	9,053,072	38,161,473
1912	213,085,400	29,785,540	2,667,300	1,673,044	9,501,968	40,960,552

Including yarn previously listed, the exports of linen manufactures amounted in 1912 to a grand total of $47,136,340.

British linen manufacturers find their best market in the United States, and of their total export the United States regularly takes as much as all other countries combined. Of the total exports of linen manufactures in 1895 the United States took 53.4 per cent; in 1900, 48.7 per cent; 1905, 50.9 per cent; 1910, 51 per cent. It is remarkable how closely, for a long period, the United States has come to taking exactly half of the total linen exports, no matter how these fluctuated.

The United States is always the best customer for piece linens, and of the $29,785.540 exported in 1912 took $15,626,015, or 52.46 per cent. The United States takes very little sailcloth, the best markets for this article being found in Australasia, India, and Germany. Of the checked, printed, dyed, damask, and diaper, the United States takes from one-fourth to one-third, and is followed by Australasia, Cuba, Brazil, Canada, and Argentina; but of the plain bleached and unbleached linens the United States takes nearly two-thirds, much smaller amounts being purchased by Canada, Australasia, Cuba, Argentina, India, Germany, Brazil, Egypt, and Japan.

The best market for linen thread is found in Australasia, with the United States second, other good customers being Germany, Canada, France, Sweden, and Norway. Of the embroidered and made-up goods, etc., classed as unenumerated, the United States is by far the best customer, taking over half; other buyers are Canada, Australasia, South Africa, Switzerland, and Argentina.

It is interesting to note that while British cotton manufacturers look to the East for their customers, selling most largely in India and China, flax manufacturers look to the West, for with the exception of a diminishing amount shipped to Europe, the linen exports go west, and the United States alone takes half the total.

The United States is such an important factor that the prosperity of the Irish industry largely depends upon the fluctuations of the American demand; a money crisis in the United States, a panic, a boom, a change in the linen tariff, promptly results in an increase or a decrease in the output of the linen looms of the Emerald Isle.

IMPORTS OF LINEN GOODS.

The year 1912 was an exceedingly prosperous one for the trade, and the exports of British linens continue to increase. However, in some lines they are beginning to find increasing competition at home, particularly with cheap goods from Belgium. The imports into the United Kingdom of foreign-made manufactures of linen—excluding linen yarn previously noted—in recent years have been as follows: 1895, $1,740,221; 1900, $2,678,317; 1905, $3,658,309; 1910, $4,421,040; 1911, $4,447,115; 1912, $5,074,679. These figures are for net imports—that is, imports less reexports—and they show a rapidly increasing import. Half of the total imports of linen manufactures come from Belgium, and over a fourth from Germany, with smaller amounts from France, Russia, and other countries. By value, about half of the imported manufactures are classed as piece linens and about half as unenumerated made-up articles. The import of piece linens came to 12,759,999 yards in 1911 and 14,924,172 yards in 1912.

According to testimony before the British Tariff Commission of 1905 British shopkeepers seem to think that linen is a luxury and therefore take much higher profits than they do on cotton. Linen costing 4d. to 6d. (8 to 12 cents) a yard was sold across the counter for 18d. (36 cents), etc., and manufacturers claimed this tended to retard the demand for real linens. Various cotton cloths, it was stated, were largely sold as linens, as it is difficult, before the goods are washed, for an inexperienced buyer to know the difference.

It is against the law for an article to be misdescribed, such as cotton being marked as linen, or foreign linen being marked as Irish linen. In this connection it may be stated that the industrial movement started in Ireland a few years ago has produced the first national trade-mark ever registered, and that the Irish Industrial Association, and in particular the affiliated Belfast Industrial Development Association, works actively to safeguard Irish produce against fraud and imitation. In both Ireland and Great Britain they have recently worked up evidence for successful Government prosecutions against those selling cotton as linen, and foreign linen as "Irish linen."

IRISH LINEN MILLS.

According to figures compiled by the Flax Supply Association of Belfast, the status of the machine manufacture of flax in Ireland has been as follows:

Years.	Spinning spindles.	Doubling spindles.	Power looms.	Years.	Spinning spindles.	Doubling spindles.	Power looms.
1841	250,000	.....	.....	1885	873,910	20,372	24,300
1850	326,008	.....	88	1890	827,451	26,544	26,592
1856	567,980	.....	1,871	1895	849,410	24,301	28,764
1864	650,774	14,648	8,187	1900	846,934	24,840	32,245
1871	866,482	20,178	14,834	1905	851,388	20,328	34,498
1875	924,817	18,192	20,152	1910	945,962	19,120	36,892
1880	883,075	15,943	21,177	1911	945,962	19,120	36,942

The enumeration made by the association in 1912 is not yet published, but the secretary states it will show an increase of about 5,400 spindles, making the total 951,362, with the looms unchanged.

CHIEF MANUFACTURING DISTRICTS.

With the exception of a very few mills located at Cork, Drogheda, Dundalk, and Dublin the industry is confined to the Province of Ulster. Ireland is divided into four Provinces—Ulster, Leinster, Connaught, and Munster—and these into counties. Of the nine counties of Ulster, the flax-manufacturing plants lie mainly in Antrim, Armagh, Down, and Tyrone. In 1911 Antrim, with 478,603 inhabitants, was the most populous county of Ireland, followed by Dublin, with 476,909, and Down, with 304,589.

Belfast, the capital of Ulster, is much the largest center for spinning, weaving, and making up linen goods, and practically all the imports and exports are handled there. Belfast is the commercial and industrial capital of Ireland as well as its largest city. It had 349,180 inhabitants in 1901 and 386,947 in 1911, an increase of 10.82

per cent in 10 years. Of the inhabitants in 1911, 205,679 were females and only 181,268 males. Belfast is noted for shipbuilding and other enterprises as well as flax manufacture, but the linen mills require so many women and girls that, with the greater emigration of men, the census figures always record an excess of females.

Outside of Belfast the chief weaving centers seem to be Lurgan, Portadown, Ballymena, Armagh, and Cookstown, with spinning mills at Killyleigh, Whitehouse, Ballymena, etc., and thread works at Lisburn, Dunmurry, and Banbridge. Most of the bleaching greens are in the country districts of Antrim and Armagh Counties.

DIVISIONS OF INDUSTRY.

Of 43 linen manufacturing firms in Belfast in 1913, 11 had spindles only, 24 had looms only, while only 8 had both spindles and looms. In 1871, of 14,834 looms in Ireland 6,579 were attached to spinning mills and 8,255 were in separate plants; in 1885, of 24,300 looms, 11,103 were attached to spinning mills and 13,197 were in separate plants; while in 1911, of 36,942 looms, only 8,693 were attached to spinning mills and 28,249 were in separate plants. The tendency to separate spinning and weaving is due partly to the advance of specialization and the greater care necessary in each branch, and partly to the fact that the increasing variety of goods now required of a linen weave mill necessitates such a variety of yarns that it is more convenient to buy than to spin them.

The linen industry, however, is not yet divided into what has been called the water-tight compartments of spinning, weaving, bleaching, and distributing, as is the case in the Lancashire cotton industry. The three largest plants—the York Street Flax Spinning Co. (Ltd.), William Ewart & Sons (Ltd.), and the Brookfield Linen Co. (Ltd.)—are flax spinners, linen manufacturers, and bleachers, as well as merchants employing traveling men in foreign countries and carrying stocks of goods at their branch houses in New York, Paris, Berlin, etc. These three firms do everything from buying the flax to putting the goods into the hands of the foreign importer without intermediaries, and in their shipping departments one sees cases of packed and ticketed goods being marked for importers in every country in the world.

PRINCIPAL LINEN MANUFACTURERS.

The York Street Flax Spinning Co. (Ltd.) claims to be the largest linen-producing company in the world. The York Street and York Road mills of this concern at Belfast have 63,000 spindles and 1,000 looms, and in addition it has large bleaching, dyeing, and finishing works for both yarn and cloth at Muckamore, in County Antrim. This concern, at first known as Andrew Mulholland & Son, built in 1828 the first spinning mill driven by steam power in Ireland. In 1864 the concern was transformed into a limited liability company under the present name, being the first in Belfast to be registered as limited.

A great majority of the firms in the Irish linen industry are now limited-liability (that is, joint-stock) companies, and some send regular reports to their stockholders and offer their shares to the

public. Other firms are private limited, offer no shares to the public, and keep their accounts secret.

There is no trust in the linen industry, with the exception of thread manufacture. The Linen Thread Co. (Ltd.) has absorbed the business of the following: Wm. Barbour & Sons (Ltd.); Finlayson, Bousfield & Co. (Ltd.); W. & J. Knox (Ltd.); Dunbar, McMaster & Co. (Ltd.); F. W. Hayes & Co. (Ltd.); Ainsworth & Sons (Ltd.); and Robert Stewart & Sons (Ltd.). It controls the manufacture and export of Irish linen thread of all kinds.

According to figures in the 1913 directory published by John Worrall (Ltd.), of Oldham, the largest firms in the Irish linen industry, those having over 10,000 spindles or 500 looms, are as follows:

Firms.	Location.	Spindles.	Looms.
SPINNING AND WEAVING.			
York Street Flax Spinning Co. (Ltd.)	Belfast	63,000	1,000
Ulster Spinning Co. (Ltd.)	do	55,500	408
William Ewart & Son (Ltd.)	do	33,500	1,800
New Northern Spinning & Weaving Co. (Ltd.)	do	25,000	750
Brookfield Linen Co. (Ltd.)	do	24,000	1,400
Lindsay, Thompson & Co. (Ltd.)	do	23,000	450
Bessbrook Spinning Co. (Ltd.)	Bessbrook	20,000	760
Richardson, Sons & Owden (Ltd.)	Belfast	20,000	760
Cork Spinning & Weaving Co. (Ltd.)	Cork	19,150	200
Blackstaff Flax Spinning & Weaving Co. (Ltd.)	Belfast	18,000	312
Falls Flax Spinning Co. (Ltd.)	do	15,000	640
Whitehouse Spinning Co. (Ltd.)	Whitehouse	15,000	200
Thomas Sinton (Ltd.)	Tandragee	12,000	360
SPINNING ONLY.			
J. & T. M. Greeves (Ltd.)	Belfast	70,000	.....
Philip Johnston & Sons (Ltd.)	do	31,000	.....
Braird Water Spinning Co. (Ltd.)	Ballymena	30,000	.....
Edenderry Spinning Co. (Ltd.)	Belfast	27,392	.....
Herdmans (Ltd.)	Sion Mills	26,000	.....
Doagh Flax Spinning Co. (Ltd.)	Doagh and Belfast	24,500	.....
Wolfhill Spinning Co. (Ltd.)	Belfast	23,000	.....
John Martin & Co. (Ltd.)	Killyleigh	20,244	.....
Dunbar, M'Master & Co. (Ltd.)	Gilford	20,000	.....
Thomas Sinton & Sons	Killyleigh	18,500	.....
Whiteabbey Flax Spinning Co. (Ltd.)	Whiteabbey	18,316	.....
Gunning & Campbells (Ltd.)	Belfast	18,000	.....
John Barbour & Co. (Ltd.)	Whitehouse	16,600	.....
James Taylor & Sons (Ltd.)	Carrickfergus	16,414	.....
Belfast Flax & Jute Co. (Ltd.)	Belfast	14,972	.....
Cogry Flax Spinning Co	Doagh	14,000	.....
Thomas Adair & Co	Cookstown	13,000	.....
Armagh Spinning Co. (Ltd.)	Armagh	12,308	.....
Morrison & Metcalfe	Belfast	12,000	.....
Robert Stewart & Sons (Ltd.)	Lisburn	12,000	.....
James Murland (Ltd.)	Annsborough	11,000	.....
Portadown Spinning Co. (Ltd.)	Portadown	10,000	.....
WEAVING ONLY.			
Boyne Spinning & Weaving Co. (Ltd.)	Drogheda	.....	1,500
Milfort Weaving & Finishing Co. (Ltd.)	Belfast and Dunmurry	.....	1,000
John S. Brown & Sons (Ltd.)	Lurgan and Belfast	.....	[1] 950
Johnston, Allen & Co.	Lurgan	.....	800
Durham Street Weaving Co. (Ltd.)	Belfast	.....	800
Rosebank Weaving Co. (Ltd.)	do	.....	750
McCrum, Watson & Mercer (Ltd.)	Armagh	.....	750
Spence, Bryson & Co. (Ltd.)	Portadown	.....	700
Lurgan Weaving Co. (Ltd.)	Lurgan	.....	670
Loop Bridge Weaving Co. (Ltd.)	Belfast	.....	648
Broadway Damask Co. (Ltd.)	do	.....	600
Watson, Armstrong & Co.	Portadown	.....	600
Achesons (Ltd.)	do	.....	510
Hamilton Robb (Ltd.)	do	.....	500

[1] Also operate 750 hand looms.

The largest number of spindles in one concern is 70,000, in the spinning firm of J. & T. M. Greeves (Ltd.), while the largest number

of looms in one concern is 1,800, operated by William Ewart & Son (Ltd.). Most of the Irish looms are probably on pure linen, but there is an increasing number of looms on unions, goods made partly of linen and partly of cotton yarn, which cater to the demand for cheaper linens. As cotton takes and holds dyestuffs better than linen, owing to the fiber being softer and more penetrable, unions are preferred for many fancy dress goods. The 1,500 looms of the Boyne company at Drogheda are partly on linen and partly on cotton and unions.

Power-loom weaving has superseded the hand loom, but there are still some hand-loom workers in parts of Down, Armagh, and Antrim, especially around Lisburn. They make a few sheer lawns for dresses, but as the competition of the power loom is strongest on plain goods, most of the hand looms work on extra-heavy damasks, diapers, etc. On some qualities of damask hand-loom weavers can turn off 4 yards or more a day, but the usual output is 2 to 3 yards. Sir William Crawford estimated the wages paid annually for hand-loom weaving in Ireland as £220,000 ($1,070,630) in 1893 and £55,000 $267,660) in 1910. The firm of John S. Brown & Sons (Ltd.) is listed as operating 750 hand looms in connection with its 950 power looms.

The York Street Flax Spinning Co. (Ltd.) is exceeded by other firms in number of spindles and looms, but taking both spindles and looms into account, together with its manufacture of made-up articles, its big bleaching establishment, etc., this firm claims to be the largest linen concern in the world.

FINANCIAL STATUS OF LARGER FIRMS.

The following published information in regard to this and other prominent firms gives some insight into the industry:

York Street Flax Spinning Co. (Ltd.).—Spinners, manufacturers, bleachers, and merchants. Authorized capital, £650,000, divided into 25,000 6 per cent cumulative preference shares of £10 each, and 16,000 ordinary shares of £25 each. Capital issued and paid up, £550,000; also, in addition, £250,000 fully paid 4½ per cent debenture stock. Accounts are made up to June 30, an interim dividend being paid in January. Recent dividends (free of income tax) on the ordinary shares have been for 1907–8 to 1911–12 at rate of 8 per cent a year. On the £25 fully paid, ordinary shares, the market quotations on the 1st of January for 1911, 1912, and 1913 were £42½, £40½, and £38. The capital of this company was originally £250,000, but was increased to £500,000 in 1888 and to £650,000 in 1897.

William Ewart & Son (Ltd.).—Spinners, manufacturers, bleachers, and merchants. Capital £500,000, divided into 20,000 shares of £25 each, fully paid. This is a private limited company and no stock is offered or dividends published.

Brookfield Linen Co. (Ltd.).—Spinners, manufacturers, bleachers, and merchants. Subscribed capital, £500,000, divided into 20,000 5 per cent cumulative preference shares of £10 each, fully paid, and 8,000 ordinary shares of £50 each, with £25 per share paid up. Accounts are made up to October 4, an interim dividend being paid in May. Dividends on ordinary shares for 1906–7, 7 per cent; 1907–8 to 1911–12, 5 per cent a year. On the ordinary shares with £25 paid up the market quotations on the 1st of January, 1911, 1912, and 1913 were £19½, £17¾, and £18.

Edenderry Spinning Co. (Ltd.).—Flax and tow spinners. Capital stock, £120,000, divided into 12,000 shares of £10 each, fully paid. Dividends last three years at rate of 6 per cent a year. Stock quoted on the 1st day of January, 1911, 1912, and 1913 at £12¾, £10¼, and £10, respectively.

Philip Johnston & Sons (Ltd.).—Flax and tow spinners. Capital stock, £112,500, divided into 15,000 shares of £7 10s., fully paid. Dividends last three years at rate of 6 per cent a year. Stock quoted on 1st day of January, 1911, 1912, and 1913 at £8¼, £8, and £8, respectively.

TOTAL CAPITAL EMPLOYED AND WAGES PAID.

Sir William Crawford, head of the largest linen concern, estimated the capital employed in the Irish linen trade in 1910 as follows: 935,000 spindles, at an average price of £5 each, £4,675,000; 36,000 power looms at £50 each, £1,800,000; bleaching, printing, and finishing works, estimated at £500,000. These amounts added together would show a total of £6,975,000 (in round figures $34,000,000) in plant alone. In addition to this are stocks of raw material and of goods in the process of manufacture and in a finished state valued at £5,000,000 or £6,000,000. Furthermore, capital is employed in giving credit to buyers, and whether this be in the form of discountable bills or of open accounts, it amounts to over £2,000,000. The grand total of capital employed would thus amount to at least £14,000,000, or, in round figures, $70,000,000.

Sir William Crawford also estimated the amount paid in wages to operatives as follows: 67,027 men, women, and young persons, at an average of 12s. 6d. ($3.04) per week, £2,178,377; bleachers, printers, and finishers, £400,000; embroiderers, hemstitchers, and warehouse hands, including lappers, ornamenters, and box makers, £400,000; hand-loom weavers, £55,000. Besides all these there are clerks, managers, and other officials whose salaries would amount to £250,000, giving a grand total for annual wages and salaries of £3,283,377 (approximately $16,000,000).

Flax-spinning mills are given as costing complete £6 to £8 ($29.20 to $38.90) per spindle. A power-loom factory for the weaving of light and narrow linens costs, complete, £40 to £50 ($195 to $243) per loom, while a weave shed for making wide damask or sheetings costs £100 ($487), or even up to £200 ($973) per loom.

CONSTRUCTION AND ARRANGEMENT OF FACTORIES.

Most of the Belfast linen factories are well constructed and conveniently arranged, and the majority of them are equipped with up-to-date machinery. Several that had old types of machinery have taken advantage of recent good times to replace them with more modern machines, and others are contemplating changes. The weave sheds are mainly of the one-story, saw-tooth roof type, with cast-iron columns and with floors of stone flags or cement. The spinning mills are usually four or five stories high. Besides convenience and economy of ground space, this arrangement reduces the roof condensation, which is of importance in the wet-spinning rooms generally found in Ireland, as unequal degrees of temperature and humidity greatly affect the spinning of flax yarns, especially fine counts. The heavy hackling machines are usually in a separate building or on the first floor of the main building, together with the carding and tow-preparing rooms. The hand-hackling operations of roughing and sorting occupy the first floor, on which are frequently also the flax storerooms. The second floor contains the line-preparing room; the

third and possibly the fourth the spinning rooms, while the reeling room is usually on the top floor. The drying loft is usually over the boilers. The roof is usually flat, frequently of armored concrete, with parapet. Because flax-spinning machinery is very heavy the buildings have to be solidly constructed. For wet-spinning the bays are usually 9 feet wide. The modern mills are built wider than the old ones to accommodate the longer frames now used, and may be 57 to 70 feet wide, to suit two rows of 23 to 30-foot frames and leave a 6-foot passage down the middle.

The so-called warehouse, where the finished cloth is embroidered, ornamented, hemstitched, made into handkerchiefs, etc., and the cloth and articles folded, ticketed, packed, and marked for shipping, is also four or five stories high and usually adjoins the manufacturing section. The bulk of the cloth after weaving is sent to bleaching greens in the country districts to be bleached and finished, which usually requires about three weeks, and then comes back to the warehouse to be folded and packed or else to be made into various classes of articles before shipping.

RAW MATERIALS.

The great bulk of the flax manufactured in the United Kingdom is of foreign growth, chiefly Russian. In 1912, for instance, there was an import of 195,054,720 pounds of flax and 42,228,480 pounds of flax tow. The reexports were 6,937,280 pounds of flax and 931,840 pounds of tow, leaving available for manufacture 188,117,440 pounds of flax and 41,296,640 pounds of tow, or a total net import of 229,414,080 pounds. The production of flax in Ireland in 1912 is given as 28,945,280 pounds, and in England as 179,200 pounds, but there was an export of 12,812,800 pounds, leaving only 16,311,680 pounds of home-grown flax available for manufacture. Of the flax supply of the United Kingdom in 1912, amounting to 245,725,760 pounds, 229,414,080 pounds, or 93.36 per cent, was imported, and 16,311,680 pounds, or 6.64 per cent, home grown. The amount of Irish flax retained forms a very small proportion of the total.

SOURCE OF FLAX SUPPLY.

In recent years the total flax supply of the United Kingdom has been obtained as follows, the amounts being given in English tons of 2,240 pounds:

Years.	Irish supply.	English supply.	Flax imported.	Flax tow imported.	Flax and tow reexported.	Irish flax exported.	Net supply of flax and tow.
1900	9,479	93	58,442	13,144	2,577	1,179	77,402
1905	10,073	96	74,794	15,304	2,596	1,455	96,216
1910	9,738	48	69,479	18,963	2,668	4,499	91,161
1911	11,635	78	62,311	17,718	1,384	4,384	85,974
1912	12,922	80	87,078	18,852	3,513	3,720	109,699

The Flax Supply Association shows the net Irish supply to have been 37,253 tons in 1900, 47,365 tons in 1905, 46,849 tons in 1910,

and 44,873 tons in 1911. Ireland accounts for only about half of the flax used in the United Kingdom, though it has 80 per cent of the spindles. This is due to the fact that Irish spindles are on finer counts and the turn-off per spindle is much less than that of a coarse spindle in England or Scotland.

CONSUMPTION PER SPINDLE.

Government figures as to flax spindles show that in 1905 there were 812,952 in Ireland, 49,941 in England, and 160,085 in Scotland, a total of 1,022,978. The flax supply in 1905 was 96,216 tons, or 215,523,840 pounds, which gives an average supply per spindle of 210.7 pounds. The 812,952 spindles of Ireland, however, consumed only 47,365 tons, or 106,097,600 pounds, which is only 130.5 pounds a spindle; while the remainder of 48,851 tons, or 109,426,240 pounds, was left to the 210,026 spindles of England and Scotland, giving them an available supply per spindle of 521 pounds. Ireland uses wet spinning and manufactures mainly fine counts into cambrics and other fine plain-woven goods, while Scotch and English mills use dry spinning and manufacture medium and coarse yarns into heavier domestic linens, ducks, dowlas, canvas, etc.

COUNTRIES SUPPLYING IMPORTS.

The gross import of flax and flax tow into the United Kingdom in 1912, by countries, was as follows:

From—	Flax.		Flax tow.		Total.	
	Tons.	Value.	Tons.	Value.	Tons.	Value.
Russia	68,453	$13,518,704	12,366	$2,024,415	80,819	$15,543,119
Belgium	16,205	6,917,871	5,465	497,113	21,670	7,414,984
All other countries	2,420	725,863	1,021	126,573	3,441	852,436
Total	87,078	21,162,438	18,852	2,648,101	105,930	23,810,539

Of the total import of flax and flax tow, about three-fourths comes from Russia and about one-fifth from Belgium. The small remainder is supplied chiefly by the Netherlands, with a trifle from France, Germany, and other countries. Flax and tow are usually quoted and sold in the United Kingdom by the ton of 2,240 pounds, though in most Irish markets home-grown flax is sold at so many shillings per stone of 14 pounds, and in a few others at so much per hundredweight of 112 pounds.

From the foregoing statement of the 1912 imports it is clear that the best flax comes from Belgium; it averaged $426.90 per ton, while the Russian averaged only $197.50. Russian tow, however, averaged $163.71 per ton, as against an average of only $90.96 for the Belgian tow. The Belgians work up their best tow themselves.

Russia produces practically all the coarse flax consumed in the United Kingdom and Belgium all the fine flax; Ireland supplies only a portion of its requirements in the medium qualities. Irish flax, though inferior to the Belgian, is nevertheless much better than the

Russian and is noted for its strength, which makes it unequaled for certain qualities of thread. Large quantities of hand-scutched Irish flax were formerly employed in canvas manufacture.

DECLINE IN IRISH FLAX PRODUCTION.

The production of flax in Ireland has declined greatly, as shown by the following table:

Years.	Acreage.	Production.		Average price.	
		Average per acre.	Total.	Per ton.	Per pound.
		Pounds.	*Tons.*	£ *s. d.*	*Cents.*
1860	128,595				
1864	301,693	479	64,506	58 4 3	12.65
1870	194,893	354	30,771	54 17 6	11.92
1880	157,534	348	24,508	55 17 4	12.14
1890	96,871	464	20,045	50 14 1	11.01
1895	95,202	305	12,972	43 16 8	9.52
1900	47,451	447	9,479	60 2 9	13.06
1905	46,158	488	10,073	56 .. .	12.16
1910	45,974	474	9,738	80 .. .	17.38
1911	66,618	391	11,635	64 .. .	13.90
1912	54,931	527	12,922	65 .. .	14.12

The production per acre and the total production have fluctuated greatly, as has also the price. The highest average price recorded for an Irish flax crop was £82 12s. per ton (17.95 cents a pound) in 1868, while the lowest was £39 16s. 10d. per ton (8.65 cents a pound) in 1896.

Flax is grown more or less in all the nine counties of the Province of Ulster, but mainly in Down, Antrim, Londonderry, Tyrone, and Donegal. In the other three Irish Provinces—Munster, Leinster, and Connaught—there are a few acres in flax, but the amount raised is negligible, and Ulster is practically the only one that attempts this crop.

The Irish soil and climate are so suitable for growing flax and the demand from local mills so large that one would naturally expect the bulk of the supply to be raised at home; instead, the acreage has declined greatly and there is no prospect of its attaining its former record. The comparatively large acreage in 1911, the largest since 1896, was induced by the high prices then prevailing, but with a reduction in price the acreage again fell in 1912.

CAUSES OF DECLINE.

The decline in Irish flax growing has been due to a combination of causes, chief among which are the facts that Russia, with its extremely low rate of farm wages, can grow flax much cheaper; that labor in Ireland is not so plentiful as it once was nor so cheap; that inferior seed has often been used with resultant poor crops; that the flax crop requires great care and labor and so much preparation for the market that the farmer almost turns manufacturer; and that, with the lack of competition among home buyers, it is much less troublesome, and at the usual level of prices almost if not fully as

remunerative, to raise potatoes or other crops. Flax has to be carefully watched and tended and must be pulled at the moment it is ready. Steeping and drying must be done at the right time and for just the proper period. It is difficult now to get enough hands to do the work, especially as the demand usually comes just when labor is needed for other crops, and the Irish country districts are becoming depopulated. Seventy years ago the population of Ireland was about double that of to-day. Census figures show a steady decline in the population since 1841, when it reached its maximum, as follows: 1841, 8,196,597; 1851, 6,575,278; 1861, 5,798,967; 1871, 5,412,377; 1881, 5,174,836; 1891, 4,704,750; 1901, 4,458,775; 1911, 4,381,951.

On the other hand England, Wales, and Scotland have been steadily increasing in population. In 1841 Ireland had 8,196,597 inhabitants to Scotland's 2,620,184, while in 1911 Scotland had 4,759,445 to Ireland's 4,381,951. This depopulation has resulted in some increase in wages, and has made it especially difficult to get sufficient labor, particularly for a crop like flax, the pulling, retting, and drying of which require at certain periods a large force of labor, whose remuneration can not be large. The growing and manufacturing of flax is essentially a low-wage industry, despite the high price of the finished product. This anomaly is due to the fact that flax requires much labor, especially handwork.

GROWING AND PREPARATION OF FLAX FOR MARKET.

The flax plant is an annual, sown in the spring and pulled in the autumn. The stalks grow 2 to 3 feet high and bear blue flowers. Usually 2 bushels, of 56 pounds each, are sown to the acre. The Irish crop is grown for the fiber only, hence it is pulled before it comes to full maturity and all seed for planting must be imported. About two-thirds of the seed imported for this purpose is Russian seed from Riga and about one-third Dutch. The plant grows best on a deep sandy loam. It is peculiarly liable to deterioration from weeds, and all weeds have to be carefully removed before the plant exceeds 6 inches in height. In order to obtain the greatest amount of fiber, flax, instead of being reaped like wheat and other crops, is pulled up by the roots, this being an easy operation owing to the shortness of the tap root.

Flax is retted (that is, rotted) in various ways. The world's best flax comes from the Courtrai district in Belgium, where it is retted, sometimes twice, in the sluggish waters of the river Lys, while plenty of time is allowed for stacking and grassing. In Russia flax is largely retted by spreading it out thinly on the grass and leaving it to the action of the elements, this being called dew retting. Retting is a tedious operation, and though chemical treatment has not been successful in producing a good fiber, in some places on the Continent improved systems of retting have proved quite successful in reducing the time required. By this system the flax is raised and lowered mechanically in tanks and then dried in sheds.

In Ireland flax is retted in shallow artificial ponds, called retting dams, which are usually about 50 feet long, 10 feet wide, and about 4 feet deep. The sheaves of pulled flax, after the rippling or removal of the seed in a coarse hackle, are placed in the pond vertically, with

root ends down, leaning against the bank and against each other, until the pond is full. A covering of rushes and sod is spread over the top and the straw left to ferment. When the steeping is in progress the stench that rises from the retting dams is exceedingly offensive. The straw is usually kept in the water 10 to 11 days and is then removed by men who wade into the waters of the pond and lift out the wet sheaves. After draining on the bank for a short while the sheaves are undone, and the straw is spread out thinly and uniformly in rows over a closely cropped meadow, this operation being called grassing. Three or four days are usually required for this, and the dried straw is then bundled and stacked up for the scutching. The root ends are kept even to facilitate subsequent work.

Flax from different sections of Ireland has different values; some is worth twice as much as others, owing to the quality of the seed sown, the kind of land, and the care with which the various processes of retting, grassing, and scutching are carried out. Irish hand-scutched flax is now very rare, and most of the flax is scutched in mills located on small streams and operated by overshot wheels. In the scutch mill the stalks are usually first run through three fluted iron rollers to break the woody boon and leave the stalks more pliable, and small bunches are then held by hand so as to be struck by revolving wooden blades, which knock away the woody boon from the surrounding fiber. The fibers in flax straw form a kind of inner bark that surrounds a woody interior called the boon, and the fibers in turn are covered with a thin skin. The object of scutching is to knock out the woody boon and separate the fibers from each other. The long fibers as they come from the scutching mill are tied up in bundles, put in bags, and shipped to the mill for manufacture.

COST OF PRODUCING FLAX.

The cost of raising flax varies at different times and places. Mr. H. R. Carter, in 1909, gave the average cost of producing an acre of flax in Ireland as follows:

Items.	English currency.	American currency.
	£ *s.* *d.*	
Rent and taxes	1 14 6	$8.41
Seed	1 5	6.08
Preparing the land	1 3	5.60
Sowing	7 6	1.82
Weeding	5	1.21
Pulling	10 6	2.55
Retting	5 6	1.34
Grassing	12	2.92
Scutching	1 13	8.02
Total	7 16	37.95

Taking the average cost of production as £7 16s., or $37.95 an acre, the average yield of fiber from good land as 37½ stones of 14 pounds, or 525 pounds an acre, and figuring the average value of the flax as about 6s. per stone (10.42 cents a pound), Mr. Carter estimates the average profits per acre to be £11 5s. ($54.75) minus £7 16s. ($37.95), which is £3 9s., or $16.80.

NET YIELD OF PREPARED FLAX PER ACRE.

Ordinarily green flax as pulled weighs 5 tons, or 11,200 pounds, to the acre. Drying takes away about 55 per cent, or 6,200 pounds, leaving 5,000 pounds. From the latter amount, seeding, or rippling, takes away about 20 per cent, or 1,000 pounds, leaving 4,000 pounds. Retting, or steeping, still further reduces the quantity about 25 per cent, or 1,000 pounds, leaving 3,000 pounds. The final operation of breaking and scutching takes away approximately 82 per cent, or 2,475 pounds, leaving only 525 pounds, or 37½ stones, as the net yield.

From the 5 tons, or 11,200 pounds, of green flax as pulled one can therefore figure on only about 525 pounds of scutched flax, which is a yield of less than 5 per cent. The percentage finally sold as cloth varies according to the quality of the material, the kind of goods made, the extent to which the purification by bleaching is carried on, etc. Thorough bleaching alone will take out over 20 per cent, without considering the waste, visible and invisible, in the hackling, preparing, spinning, and manufacturing, so that usually not a great deal over half the yield of scutched flax will be sold as cloth, either as fine linens or coarse tow goods.

In Ireland flax is found to thrive best if sown after potatoes, wheat, or oats, a good rotation being oats, turnips, wheat, clover, grass, and potatoes. Flax should not be sown in the same field more frequently than once in every seven years. Many landowners are fixed in their belief that flax impoverishes the soil, and it is still customary in certain parts of Ireland, as in England and Scotland, to insert clauses in the leases of farms prohibiting the growing of flax. Most authorities, however, now agree that by following a proper rotation of crops, and by returning the waste matter of the flax to the soil in the form of manure, all that is taken away is restored. The fiber of flax, like the fiber of cotton, contains in itself little or no plant food.

PROCESSES OF MANUFACTURE.

In textile manufacturing in Ireland, as in Great Britain, distinction is made between the mill, the factory, and the warehouse. Flax is spun into yarn in the mill; yarn is manufactured into cloth in the factory; while subsequent processes, such as embroidering or otherwise ornamenting, making up into handkerchiefs, etc., folding, marking, and casing, are carried on in the warehouse. The three divisions of the work may be carried on under the same roof, but a weaver would never think of referring to herself as a mill hand, nor would a hackler or a spinner be called a factory operative.

SPINNING.

Flax is prepared and spun into two general classes of linen yarn: (1) Long, or line, yarn, and (2) short, or tow, yarn. Long line is prepared by hackling, gill preparing, drawing, roving, and spinning. Fine leas are made on wet-spinning frames and coarse leas on dry-spinning frames. Tow yarn is prepared from the short fibers combed from the material during the preparatory processes of rough-

ing and hackling. Flax tow bears the same relation to line sliver that noil does to combed top in worsted.

When very superior yarn is required, it is made from cut line, as distinguished from ordinary long line, and in such cases the ends, which contain the poorer and less uniform fiber, are cut off, and only the middle utilized. This middle varies from 12 to 18 inches or more in length. Out of very long flax two middles may be taken from 9 to 12 inches long, these very short middles being required for only the finest machinery, or where the flax is so sound and long that there would be waste in taking only one long middle, and thus throwing too much pure fiber into the ends for use in lower-grade work. The ends are never so well dressed or prepared as the middle, and can not be spun to such fine counts.

The roughing of flax that is to be converted into cut line is usually performed in a manner different from that for long line, the pieces being made much larger and being given a mere draw over the pin points to level the fiber. This style of roughing is called stacking, and Courtrai flax is treated principally in this manner. The reason for the pieces being made larger is that the fluted rollers of the breaking machine, or cutter, get a firmer hold of the piece as it is passed in to be broken, or cut, and it is thus broken square across the end with no dragged fiber.

Flax is rarely spun on the dry system to over 28 lea (equivalent to No. 10 cotton yarn), nor tow to over 16 lea; on the wet-spinning system flax is spun commercially up to 300 lea (equivalent to No. 107 cotton yarn) and a small amount up to 400 lea, and tow is spun up to about 60 lea. For exhibition purposes flax has been spun as fine as 1,100 lea (equal to No. 392 cotton counts), but neither commercially nor for exhibition purposes are flax yarns capable of being spun to the extreme attenuation of cotton yarns. Flax yarns are stronger than cotton, but much less elastic.

Scotland makes coarse yarns and uses dry spinning exclusively, while Ireland makes medium and fine yarns and uses wet spinning almost exclusively. We shall describe the processes typical of Irish flax-spinning mills.

MILL ORGANIZATION AND PROCESSES.

The average flax-spinning mill in Ireland contains approximately 20,000 spindles and employs some 750 workers, of whom about three-fourths are women and girls. The management of such a mill consists of the following: (1) The owners of the mill or directors of the company owning it; (2) a mill manager; (3) a head sorting master, a head preparing master, and a head spinning master; (4) a flax buyer and a yarn salesman.

The usual processes in an Irish flax-spinning mill are as follows:

Hackling rooms: Roughing by hand; machine hackling; sorting by hand.

Preparing room: Spreading; drawing (3 to 5 processes); roving.

Spinning room: Wet spinning.

Yarn department: Reeling; yarn drying; yarn bundling and baling.

HACKLING ROOM.

HAND HACKLING OR ROUGHING.

The first process through which flax passes in an Irish mill is the preliminary hand hackling called roughing. The stricks of scutched flax are first divided into small handfuls, or pieces. Large pieces mean cheap but imperfect hackling, while small pieces increase the cost but under ordinary conditions produce superior line. In the Belfast flax-spinning trade it is customary to piece out at the rate of 6 to 10 pieces per pound. The roughers, who are always men and who have had to serve an apprenticeship, stand in a long line facing the windows along each side of the room. In front of each is a coarse hackle consisting of some 50 or more steel pins, each 7 inches long and 5 B. W. G., set in a block. The rougher picks up a small handful of the loose fibers and by placing the root ends in the hackle and by pulling, leaves the loose and straggling ends among the spikes; he reverses the piece and repeats the operation, and then replaces the straggling fibers evenly on the piece, the last part of the operation being known as squaring. The piece is then drawn across the hackle and opened up, which removes lumps, knots, and coarse tow. (Fig. 1.)

As each end is finished on the hackle, the loose straggling fibers are broken off on a square or triangular pin at the left called a touch-pin. The rougher lays the finished piece upon his bench beside some others, withdrawing his hand in such a way that the piece is partly twisted upon itself and can therefore be easily separated from the others in starting the machine work. Layer by layer a bundle is produced weighing about 40 pounds, which is tied with three cords and sent to the hackling machine. The short fiber that remains in the hackle, when it accumulates, is worked off into tow.

Roughing is an exceedingly dusty operation, and the fine dust given off contains a high percentage of flinty particles that have a particularly injurious effect upon the lungs. Formerly consumption and other diseases were considered to be induced thereby, and even when it did not lead to such special trouble the inhalation of the flax dust was considered so to impair the constitution of the worker that British recruiting officers were forbidden to enlist any man who had ever worked at this trade. After investigation the British Government finally treated roughing as an occupation dangerous to health, and issued stringent regulations as to ventilating apparatus for drawing away the dust. In front of every rougher and just behind the hackle, there is now an opening, covered with wire gauze to prevent the passage of fiber, and a suction draught created by a fan at the end draws away the bulk of the dust created. The law requires the exhaust draught in hand-hackling, roughing, and sorting rooms to have a minimum velocity of 400 feet per minute, and specifies that the minimum area of the exhaust opening opposite each hackler shall be 50 square inches. Similar ventilating systems are also obligatory in Belgium, France, and some other countries.

FIG. 1.—Roughing. the first operation in a flax mill.

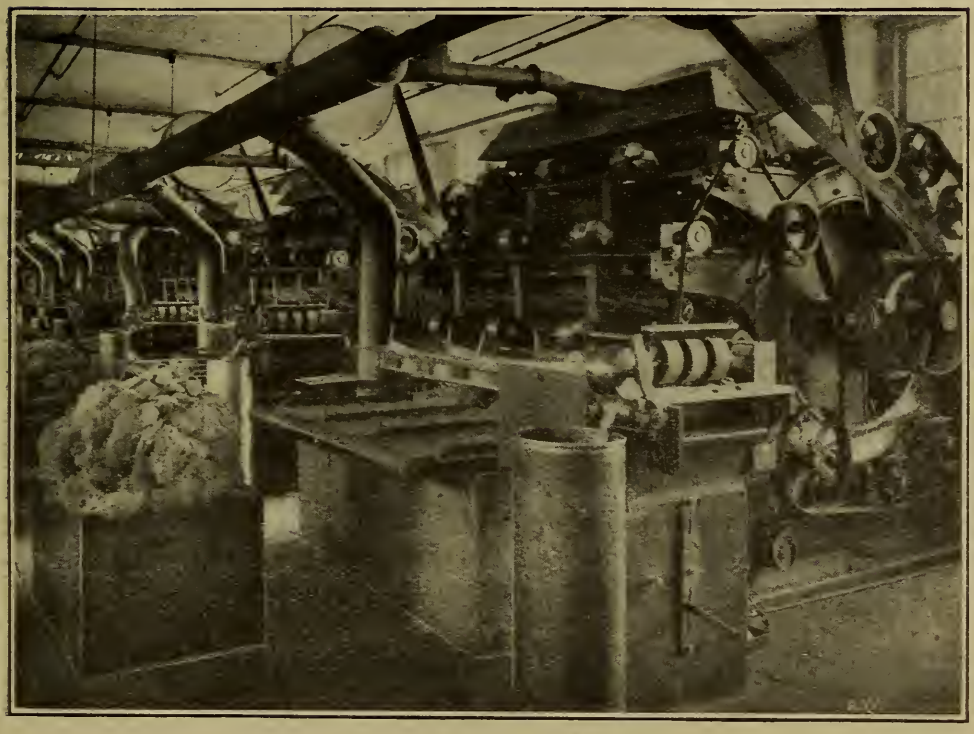

FIG. 2.—Tow carding in a Belfast mill.

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MACHINE HACKLING.

From the roughing room the material goes to the hackling machine. Hackling is a combing process, and the work of the machine may be quickly understood if one imagines a man holding up a bunch of flax in one hand while he combs it with the other, then reversing the bunch end for end and again combing. The hackling machine consists essentially of two long endless sheets of hackles revolving vertically side by side. Each long sheet really consists of several sheets side by side on the upper and lower rollers. Each of the sheets is some 70 inches in circumference and is made up of 24 to 30 hackle bars about 10 inches long, each of which carries a single row of steel pins. The machine boy, or filler, who stands at the end of the machine, lays a piece of the roughed flax in a camp, or holder, which lies open before him, and screws together the two flat sides of the clamp. He starts this clamp, or holder, with its suspended flax in the groove in a long iron channel, or head, which extends the length of the machine above the double line of revolving hackles. The head automatically lowers and subjects the piece of flax to the action of the hackles, which comb it from both sides. The head rises, the holder slides a short distance, and the head again lowers, this time subjecting the flax to the action of a sheet, or tool, as it is called, with pins spaced somewhat closer together; and this process is continued to the end of the machine, the flax being subjected to the action of finer and finer hackles. When it reaches the end, the holder is taken out and unscrewed by a boy, who draws the flax through, so as to expose the other end. He then screws it up again and passes it to another boy, who starts it on its return journey through a parallel machine, where it is alternately raised, moved forward, and subjected to the action of hackles with pins spaced successively closer and closer. It is finally received by a fourth boy, who unclamps it and lays it aside with others until he has enough to make a bundle, or tipple, as it is called, because the ends are tippled, or tied, together like a topknot. The bundle is then sent to the sorting room.

The foregoing describes the machine-hackling process, but in recent years the machine has been improved and made so automatic in action that one boy takes the place of four, the two separate machines being coupled together to form a combined, or duplex, machine. The duplex machine is tended by one boy at the front end and his work is simply to lay the pieces of roughed flax in the open holders and then to take out the hackled flax when the holders have returned after making a circuit of the machine. The machine automatically screws up the holders, starts them down one channel head, unscrews the holders at the end and draws the flax through, screws up the holders again, returns them through the other channel head, and then unscrews the holders ready for the machine boy to take out the finished piece and insert another. The improved machine, which is now largely used, not only saves in the cost of labor by one boy doing the work of four, but also makes less and more uniform tow by reason of its screwing up all holders to exactly the same holding power.

For very coarse flax the machine is arranged with as few as 9 tools, or sets of hackle sheets, with pins spaced from 1 pin in 4 inches

up to 6 pins to the inch, while for fine Courtrai flax it may have as many as 20 tools, with pins successively spaced from 1 pin in 2 inches up to as many as 56 to the inch. The closer the spacing the finer the pin, the finest ones being like small needles. The pins are usually 1 inch long. The hackle sheets usually make four to twelve revolutions per minute, and the head raises and lowers the flax four to six times, throwing out four to six holders in the same period of time. According to the size of the pieces and the number of lifts per minute, the production of the combined machine varies from 500 to 1,000 pounds a day of hackled fiber. The finest fiber is worked in the smallest pieces and with the slowest speed so as to secure the best results.

COMBINED MACHINE HACKLER AND SPREADER.

A still further improvement has recently been made whereby the labor on the ordinary spreader is eliminated by combining its operations with that of the hackling machine, so that one boy runs a combined machine that takes in roughed flax and delivers it, after hackling, in the form of sliver ready for the draw frames. The specially designed single-sliver spread board attached to the duplex hackling machine draws the flax from the holder and lays it down on the feed sheet with greater regularity than hand spreading and with much less displacement of the fibers. The resultant sliver is exceptionally level. With this machine the number of lifts per minute can be increased beyond eight, as the boy has time to spread the flax carefully in the holder and does not have to pull out and lay down the finished piece. Unfilled holders automatically stop the feed sheet, which starts again when the next full holder is presented. The automatic sliver-can packer, without any attention, presses over 50 pounds of sliver into a can 38 by 16 by 13 inches. A stop motion acts on the belt if a lump passes through the delivery rollers, if a lap forms on the delivery rollers, and when the required number of yards has been packed in the can. This combined patent automatic spreader and duplex hackling machine is the very latest improvement in flax-preparing machinery and though new is being rapidly adopted by the larger mills.

The machine tow, as a brush combs it out of the hackles revolving around the bottom sheet roller, is delivered to wire-covered doffers, from which it is struck by oscillating doffer combs and knocked into the tow boxes underneath. These tow boxes under the machine are separated into four parts and the tows are called No. 1, No. 2, No. 3, and No. 4 tow, according to whether they come from the first or following boxes. No. 1 tow, which is combed out by the widest spaced pins, is the coarsest and least valuable, and No. 4 the most valuable.

SORTING.

The tipples go from the machine-hackling room to the sorting room, where they are opened and subjected to a hand-hackling operation very similar to that of roughing, except that the hackling pins are finer and more closely spaced and the sorters are supposed to see

that all pieces placed together in a bunch are of the same color and are capable of being spun to the same lea. As in roughing, the men stand in a line along the wall and each has his own hackle and exhaust draft outlet for the dust. Sorting takes more skill than roughing, and the men have to serve a longer apprenticeship and get higher pay.

All Irish mills have hand roughing and machine hackling, but sorting, which is really a finisher process of hackling, is frequently omitted where the mill spins to only medium leas.

PREPARING ROOM.

The hackled flax goes to the preparing room, where it passes through a system of three types of machines—spreader, drawing frames, and roving frame—before it is ready for the spinning room. A system always consists of one spreader and one roving frame, but there may be from three to five or even six drawing frames, according to the fineness of the yarn to be made.

There are two ways of forming flax, hemp, and jute fibers into sliver, that is, spreading and carding. The cheaper carding process is used for coarse, cheap fibers, such as jute, tow, and low-class, or broken-up flax, while spreading is typical of long-line flax and hemp.

SPREADING.

The spreader is really a preliminary drawing frame, and its object is to draw out the loose flax fibers into a soft rope, or sliver, as it is called, for working on subsequent machines. At the back of the machine is a traveling apron, which is divided longitudinally into sections corresponding to the number of slivers to be formed, usually four for coarse work and six for fine. On each of the endless leather belts of this feed table the woman spreader places handful after handful of the shiny fiber, the successive pieces being overlapped for about three-fourths of their length to form a continuous uniform narrow layer of approximately the same thickness and weight per unit of length. As the flax is moved forward by the creeper feed it is seized by a pair of feed rollers, and as it emerges from these, rows of pins on short hackle bars, or fallers, strike up through it and carry it forward to a pair of drawing rollers. The fiber is subjected to a combing action and drawn out or attenuated in its progress by reason of the fallers moving slightly faster than the feed rollers, and the drawing rollers moving many times faster than the fallers. The short hackle bars carrying the rows of steel pins are called fallers, because, as soon as the fiber is carried forward from the feed to the drawing rollers, they fall down underneath and return again to strike up close to the feed rollers. (Fig. 3.)

For jute the fallers are arranged on an endless chain, but for flax they are fastened at each end in the grooves of an upper and lower pair of screws that serve the same purpose but enable them to work closer to the rollers and so give better work. The four or six slivers coming out at the front of the spreader are doubled into one and fall of their own weight into stationary rectangular or elliptical cans, which are then placed behind a drawing frame.

DRAWING.

The drawing frames are similar to the spreader in every respect, except that they are fed with slivers instead of loose flax, that there are three feed rollers instead of one pair, and that the hackle pins on the fallers are finer and arranged in three rows instead of two, as on the spreader fallers. Throughout flax-spinning mills the screw-gill system is preferred. The maximum speed on an ordinary screw-gill arrangement is only about 200 drops of the faller per minute, as against about 350 drops per minute on the push-bar type used for jute; but in working long-line flax quantity is always less important than quality. Where the patent disk cam with front spring is employed, however, a much higher speed can be attained in screw-gill boxes and yet give excellent work.

The successive drawing frames are similar in their general construction and alike in their object of paralleling and attenuating the slivers that pass through them. The number of drawing frames to be used, the drafts, the doublings, the pins per inch, the pitch of the screws, etc., vary according to the lea and quality of the yarn spun. For long line, the draft, or number of inches of sliver delivered for every inch fed in, will give good results with an average of 12 per machine for the system, but may vary from 10 to 15 and sometimes considerably higher. The doublings may vary from 4 to 16. For instance, in a three-drawing system for making 10s to 16s lea from long line, there may be successive doublings of 8, 6, and 4, while in a five-drawing system for making 120s to 250s there may be successive doublings of 16, 16, 8, 8, and 4.

ROVING.

The roving frame is similar in its action to the drawing machine, having feed rollers, fallers, and drawing rollers, but the finished product is called roving and is wound on large double-headed bobbins, a slight twist being inserted in the operation. In flax roving frames the flyer has a constant speed and travels faster than the bobbin. Since the flyer leads and has a constant rate of delivery, the bobbin must run more quickly when full than when empty, in proportion to its increasing circumference, and this is effected by using the Houldworth, Brooks & Doxey or other system of differential gearing. There is no doubling on the roving frame. The roving frames may have from 56 up to as many as 112 spindles, and the tendency is toward increasing speed even more than increasing the length of the frame. (Fig. 4.)

SPINNING ROOM.

WET SPINNING OF FLAX.

The bobbins of roving are carried to the spinning room and set on skewers in the creel of the wet-spinning frame. The spreader, drawing frames, and roving frame, as shown above, attenuated the successive slivers by causing the fibers (which may be 16 to 30 inches in length) to slide one upon another. They were able to do this because,

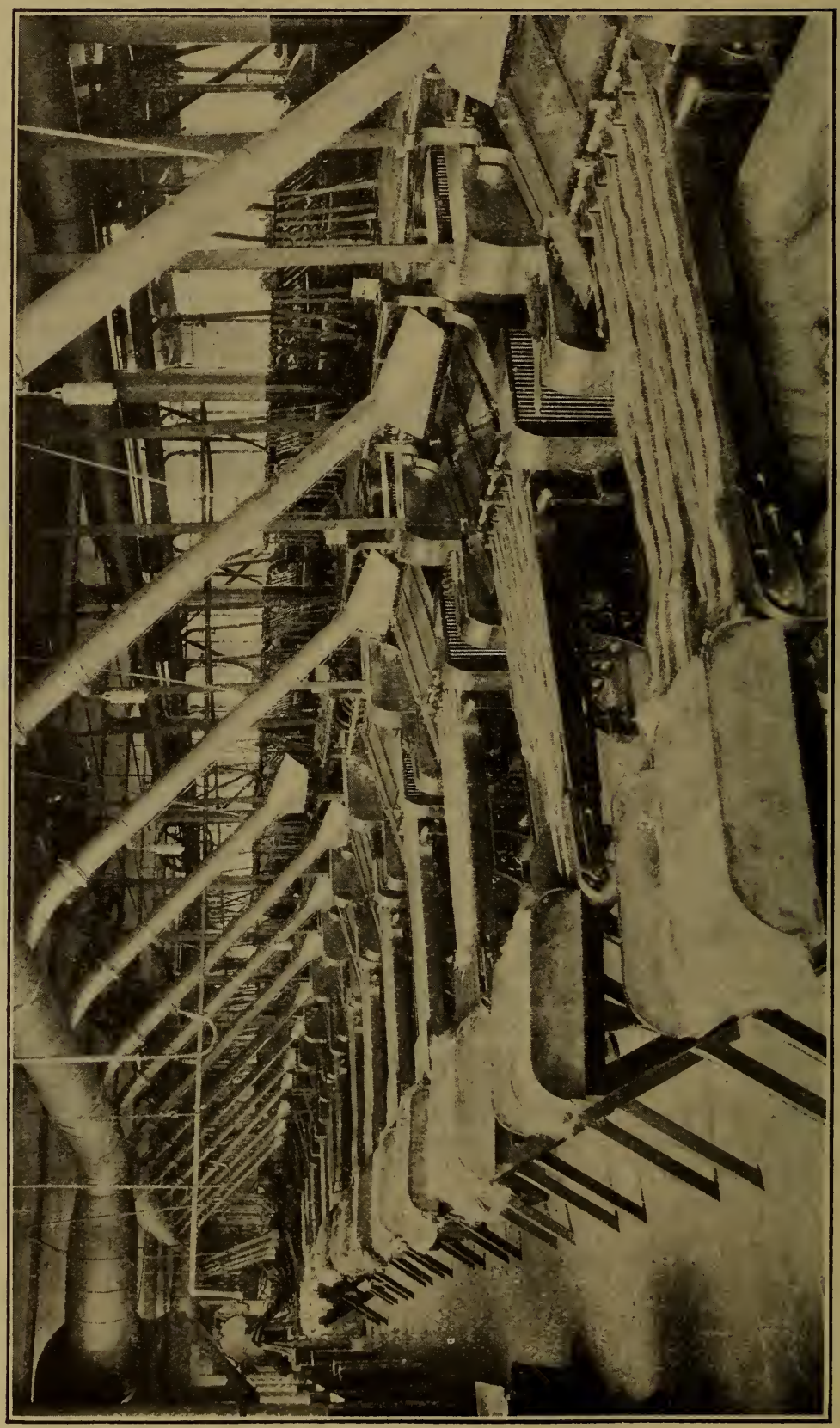

FIG. 3.—Flax spreading machine.

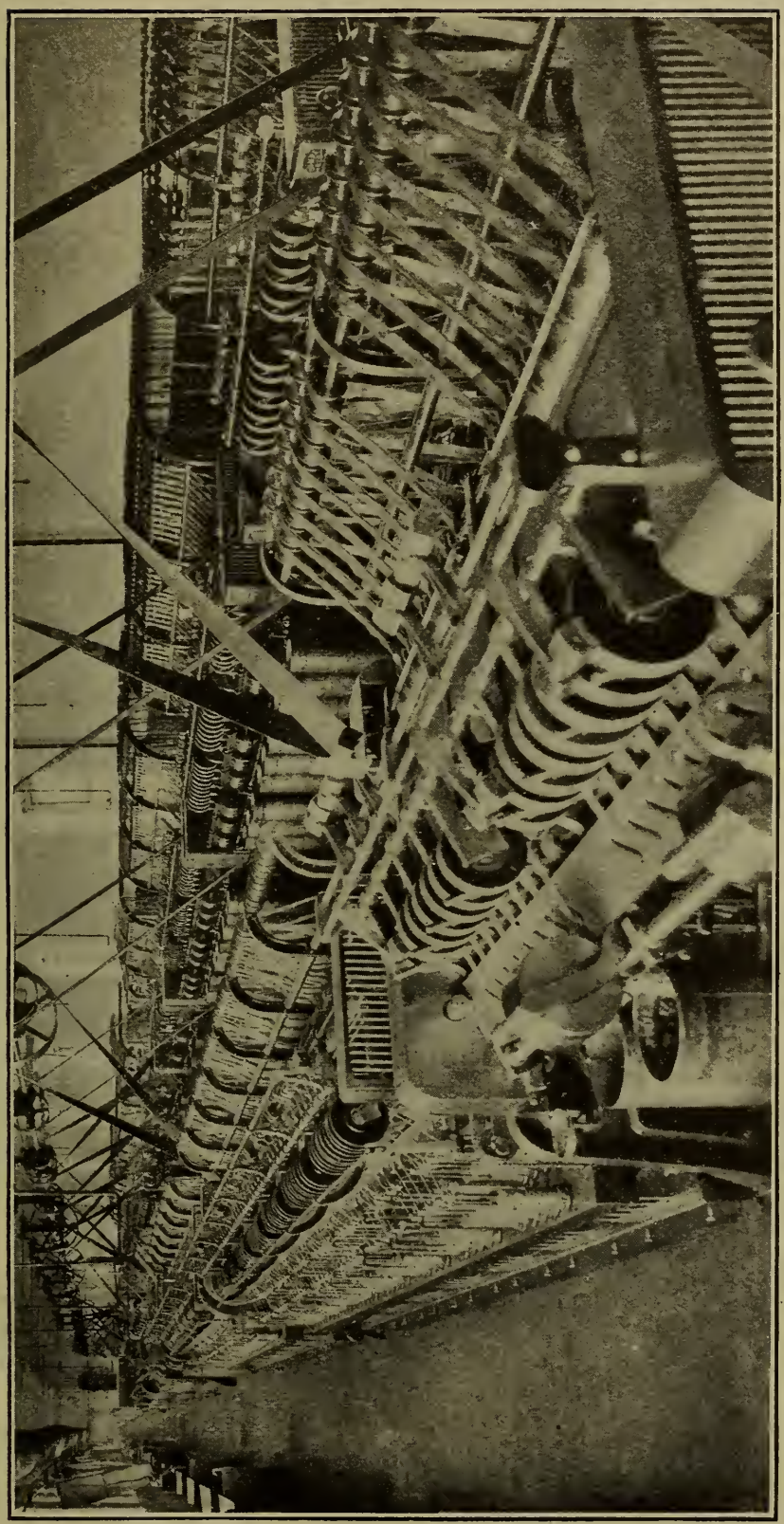

FIG. 4.—Flax roving and drawing machine.

when the drawing rollers acted on them, they were out of the grip of the feed rollers and lying only between the faller pins. Each of these long fibers of flax, however, is really made up of many short fibers that are bound together with a natural gum. These short fibers are only 1½ to 2½ inches long, and to make fine yarns the gummy coating must be loosened so they may slide upon each other and make yarn of a smaller diameter. This is done by passing the roving through covered troughs of water heated by means of steam pipes. The rove from the bobbins passes over rove guides and then under rods which hold it submerged in the troughs, whence it passes to the feed rollers over the lip of the trough and the rove shifter. There are only two pairs of rollers on a flax-spinning frame and the lower pair, which are called drawing rollers, are set only slightly forward of the upper, or feed, rollers. The distance from center to center of the two sets of rollers is called the reach, and may vary from 1½ to 4 inches, according to the kind of material worked and the fineness of the yarn required. Wet-spinning frames are always on the flyer system, as mules are unsuitable owing to the smooth, straight, and inelastic character of the fiber; ring spinning was abandoned on account of the dirt and water.

In flyer spinning the bobbin is loose upon the spindle, and is pulled around by the yarn and flyer, which leads and wraps the yarn upon the bobbin, which is dragged, or retarded, in its motion by drag bands. Along the front of the spindle rail is a notched strip, and a weighted drag band fastened to the rail back of each spindle touches the base of the bobbin and is laid in one of the notches at the front. At the start the drag bands are laid in a notch so that they just touch the bobbin, but as the bobbins fill and become heavier the drag bands are moved up notch by notch so as to exert more drag by reason of the band embracing a larger part of the base of the bobbin. This work of shifting the drag bands is usually done by the spinner, but on some frames it is now performed by an automatic arrangement. The spindles are driven by either tapes or cords; if tapes are used the spindle wharf is made barrel shaped and the tapes are either sewn together or fastened with a patent fastener. The cord, or band, system of driving, similar to that used in cotton spinning, is usually preferred, especially for fine work, and the bands are made of cotton. The bobbins are double-headed and for fine work not much larger than an ordinary spool of sewing thread. Most flax yarns are given a left-hand twist, which makes a right-hand cable twist when they are plied into thread. The number of turns twist per inch usually given to flax yarns is the product of the square root of the lea multiplied by 1.75 for weft, 2 for warps and tows, and 2¼ to 3 for yarn to be plied into thread.

Flax-spinning spindles rarely run at over 6,000 revolutions per minute. The production per spindle varies with the speed, the degree of twist inserted, and the quality of the material. On 40s lea line a production of 20 cuts, or leas, per spindle in 10 hours is considered a fair turn off. The speed is considerably higher than formerly and the length of the frames is also increasing. A common number of spindles to a side is 104, but some of the frames on very fine leas now have as many as 170 spindles to the side. (Fig. 5.)

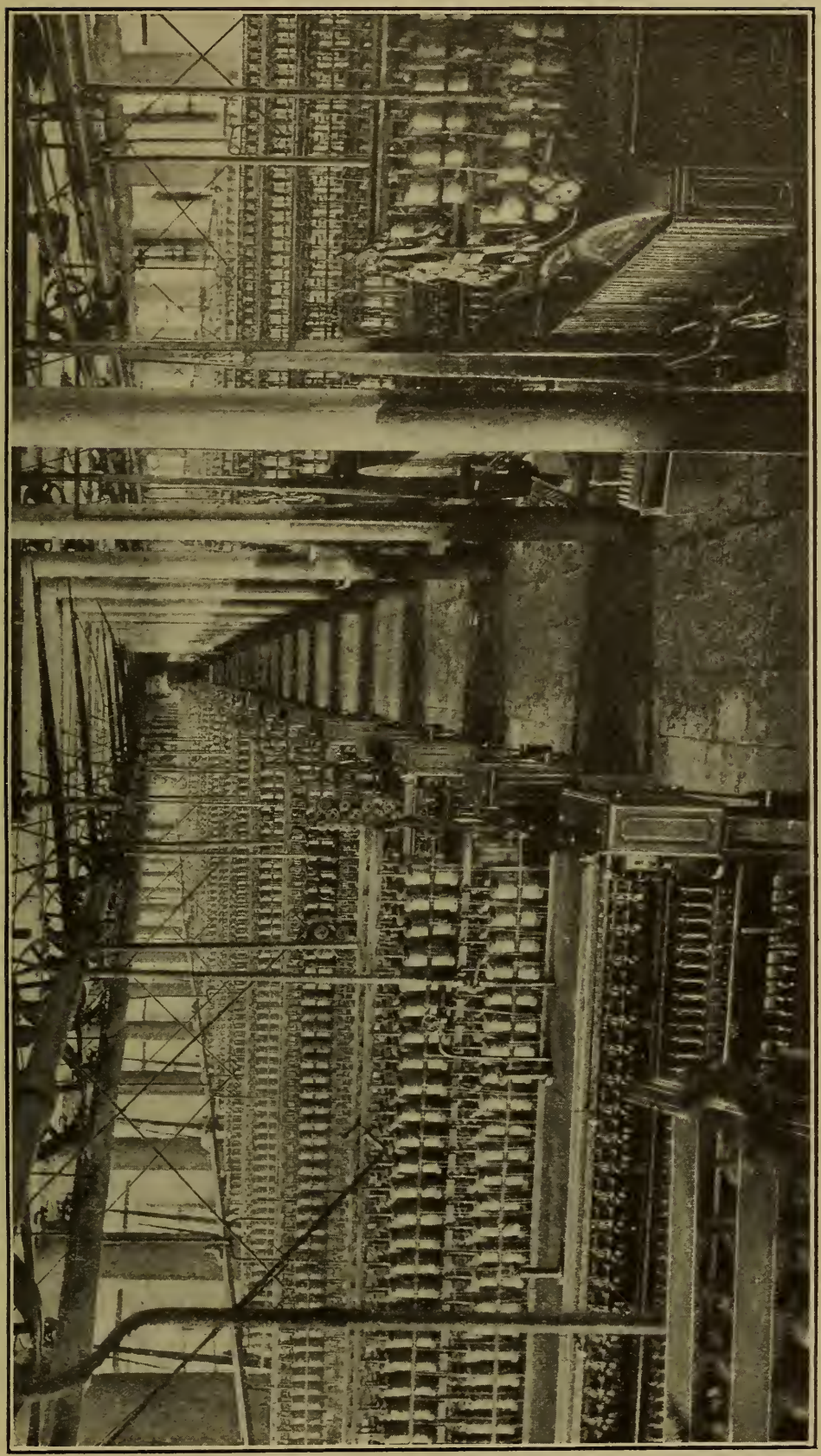

FIG. 5.—Wet-spinning frames for linen yarns.

In the preparing room, as well as in the hackling rooms, the operatives suffer considerably from the dry and dusty atmosphere unavoidably connected with their handling dry flax fiber, no matter what artificial means of alleviation is used. In the wet-spinning room they suffer from heat and dampness. The water in the troughs along each side of the frames is heated by steam, and though the troughs are covered there is a constant escape of moisture, if not of steam, into the room; water is also constantly thrown on the spinner from the damp yarn on the revolving bobbins. The law requires that spinners be provided with waterproof bibs and aprons and that coarse frames of more than $2\frac{3}{4}$-inch pitch be provided with dashboards; there are also regulations as to ventilation. In many mills the water collects in pools on the stone floor, and for women and girls to work barefoot on a wet stone floor in a steam-laden atmosphere is not very conducive to health. Fine yarns become brittle with cold, and rooms where such yarns are spun must be kept much hotter than others. In the more modern mills the spinning-room floor is laid with cream-colored tiles and is sloped in such a way that the water is drained off. The space underneath the frame is barreled, while there is a small channel along the feet on either side, and these channels and the spinners' alley itself are sloped slightly toward the wall so that all water may drain off into a larger channel by the wall and be conducted into drainpipes.

The small double-headed spinning bobbins are sent to the reel room and wound off into skeins on swifts 90 inches in diameter. They are then dried, usually in a loft over the boiler room, and then bundled or bunched for shipment. Except when the yarn is to be used green (in its natural condition) in a weave shed in the same building, in which case the yarn may be dried on the spinning bobbins or on tin warper beams, flax yarns are nearly always sent away from the spinning mill in hanks. The hanks may be either bundled or bunched. The difference is that a bundle is formed upon a bundling stool and is the full length of the hank, about 40 inches, while a bunch is formed in a bundling press in which the hanks are doubled, forming a bunch about 20 inches in length. For shipment from mill to mill the hanks are only bundled or bunched, but for export the separate bunches are put together in a hydraulic press, wrapped with paper and burlap, fastened with ties or cords, and shipped as bales.

Wet-spun yarns are known as lea yarns and are numbered differently from dry-spun yarns. The count, or lea, of wet-spun flax yarns means the number of 300-yard cuts, or leas, that weigh a pound. Thus 1-lea yarn would measure 300 yards to the pound, 10-lea yarn 3,000 yards to the pound, etc. In the complete table the circumference of the reel swift, which is 90 inches, or $2\frac{1}{2}$ yards, is called a thread; 120 threads, or 300 yards, make a cut, or lea; 12 cuts make a hank; while 200 cuts, which are $16\frac{2}{3}$ hanks, or 60,000 yards, make a bundle. In the United Kingdom, lea yarns are always sold on the basis of the bundle of 60,000 yards, and not by the pound, usually with 11 per cent discount from the quoted price for cash.

TOW-SPINNING.

Tow is the shorter and less valuable fiber that is discarded in the hackling operations in making line yarns and corresponds to the noil of a worsted mill. It is of different grades and values, according to the material and the stage of the process at which made. According to Mr. H. R. Carter, a well-known flax expert, roughing tow, Nos. 1, 2, 3, and 4 machine tow, and sorters' tow usually have relative values corresponding to the ratios 32, 35, 38, 40, 42, and 46. In tows, as in flax, there is a wide range, from the very coarse tows which can be used only for coarse sacking, up to the fine, and sometimes combed, tows which can be spun up to as high as 60s, and which are much more valuable than many coarse grades of flax. Some tows are worked by themselves, but more often various sorts are mixed to obtain lots of good average quality and color to meet a certain price.

There are various processes of making tow yarns. Tow is always prepared by carding, as the short, tangled nature of the fibers forbids the spreading preparation employed for flax line. There may, however, be one card or two, and in some cases even a combing machine; there may be two, three, or four drawing frames, and after being made into roving it may be spun either wet, dry, or by a damping process, according to the fineness, condition, and character of the yarn required. (Fig. 2.)

Where two cards are used, as is usual on the fine tows, the first, or breaker, card usually has a cylinder of 6 feet width and 4 feet diameter, fitted with workers and strippers and similar in its general action to a jute breaker card. The tangled masses of tow, after a preliminary cleansing of loose dust and dirt in a shaker, or teaser, are spread by hand on the sloping feed sheet at the back and delivered as sliver at the front. These cans are sometimes fed to the finisher card, but more usually they are put up to a sliver lap machine, which rolls the slivers under pressure into laps, two or more of which are put on the back of the finisher card. The latter is fitted with strippers and workers similar to the breaker card but arranged for finer work. The draft on tow cards is low, usually 14 or 15. The weight put through flax tow cards per day of 10 hours varies from 250 to 500 pounds, according to the grade of the material and the weight of the sliver. For certain classes of tow only one card is used after the preliminary shaking or teasing, and this card takes the place of both breaker and finisher and is frequently a full-circle down-striker card with porcupine or shell feed.

Whether one or two cards be employed, the finished-card sliver passes to the drawing. As a rule three drawing frames are used in flax-tow preparing, but very fine tows require four, and in exceptional instances five have been employed. These machines are made with feed rollers, fallers, and drawing rollers, and are similar in their action to those used for long line, but with such differences as are necessary for working the shorter-stapled and more tangled material. The rollers are smaller in diameter and the faller pins shorter, so the fallers may be brought as close as possible to the nip of the rollers and prevent the short fiber from dropping out and making excessive waste. In flax-line preparing, as previously noted, the drafts run from 10 to 15 on the drawing frames and roving, but in

tow, owing to the much shorter fiber, the drafts are much shorter and usually run from 6 to 8. After the drawing there is one roving process, and then the spinning, which is wet for fine tows and dry for coarse.

For very coarse, heavy yarns, in which cheap production is the main point, only two drawing-frame processes are used, being preceded, however, by double carding. For work as coarse as 40 pounds per spindle a rotary gill roving is sometimes used without any regular spinning process.

Tow yarns, being made of shorter fiber than line yarns, require more turns twist per inch. The number varies according to the strength and grade of the material, but is ordinarily the square root of the lea multiplied by about 2 for weft and 2.2 for warp.

YARN DEPARTMENT.

When flax has been spun into yarn, dried, and reeled, it is a finished article of commerce, but before it reaches the loom it has frequently to undergo considerable changes, such as scouring, boiling, bleaching, and possibly dyeing. Unbleached yarns are known as gray, or green, yarns and in the weaving trade cloth made from such yarns is known as green linens while that made from boiled yarn is known as boiled linens. Flax yarn contains a remarkably large percentage of impurities, including a considerable quantity of gummy substances, as well as much dirt and woody matter, amounting in most cases to fully a fourth of its weight. If this yarn is woven green and the cloth subjected to thorough bleaching, the shrinkage in the diameter of the yarns will leave the cloth looking more or less bare. To prevent this and to enable the weaving of a tighter and firmer cloth, yarns that are intended for fine white linens are usually boiled in soda lye, which not only reduces their bulk but also makes them softer and more workable. Creaming, in which the yarn is partly decolorized, is usually employed for fabrics to be sold in that condition. As a rule, yarns that are bleached are those intended for grass cloths, cream damasks, apron dowlas, huckabacks, towels, etc., which are not bleached after weaving. However, for various reasons some articles made from bleached yarns are also bleached in the piece. The proportion of loss in weight of the yarns through boiling, etc., varies not only with the extent to which the bleaching process is carried but also with the quality of the material. The approximate loss in weight caused by the various processes to which the yarn may be subjected is usually as follows: Scoured, 2 to 6 per cent; boiled, 4 to 8 per cent; twice boiled, 7 to 10 per cent; one-fourth bleached (creamed), 8 to 12 per cent; one-half bleached (high creamed), 10 to 15 per cent; three-fourths bleached, 12 to 20 per cent; full bleached, 15 to 25 per cent.

WEAVING.

Irish weave mills average about 500 looms each, and it is usually considered that in a complete weave shed the total number of operatives about equals the total number of looms. The management of the weaving factory comprises the following: (1) The owners of the factory or the directors of the company owning it; (2) a factory

manager; (3) a foreman of the yarn preparation department and under him a foreman of warp winding, a foreman of weft winding, and a warping master; (4) a number of tenters, each of whom supervises 50 to 70 looms.

A few Irish weave sheds, including some of the largest, are attached to spinning mills, but the great majority are separate and independent concerns. Spinning mills sell their flax yarns in the hank, and this is the usual state in which it is received by the weave sheds, whether it comes to them direct from the spinning mill or after going to the bleachery. If the factory is connected with the spinning mill and the yarn is to be used only in the green condition, the warp may be received upon the spinning-frame bobbins and be dried after winding on tin warpers' spools; some fine wefts are spun and dried upon perforated paper tubes in cop form, which saves both reeling and cop winding.

The ordinary processes in a linen weave shed are as follows: Weft winding onto pirns or into cops for the shuttle; warp winding onto spools or into cheeses; beam warping; dressing; drawing in; weaving.

WEFT AND WARP WINDING.

There are several different types of weft-winding machines to prepare the yarn for the shuttle by winding either from the skein or the bobbin onto pirns or into cops. Coarse flax yarns are largely copped upon a bare spindle, and in weaving the end is drawn from the inside of the cop as it is firmly held in the shuttle. Fine flax yarns, however, such as are more usual at Belfast, are wound from the skein onto paper tubes or wooden pirns and the end draws off endwise from the nose of the pirn. Because of the hard and slippery nature of flax, as compared with cotton or wool, the yarn must be wound under great tension and pressure to insure a good firm cop.

The warp-yarn skeins are placed on swifts, or ryces, and each end is wound on a spool, or warper's bobbin, as it is frequently called. This machine is usually a surface drum winder with a slow thread guide traverse and the spools are driven by frictional contact with the surface of the drum upon which they lie. They are often fitted with stop motions, consisting of leather tongues that fall down between the spool and the drum and stop the revolution of a spool as soon as an end breaks.

Some quantities of complicated striped warps are still produced by mill warping or by sectional warping, but in most linen mills beam warping is now the rule. Spools from the warp-winding machine are placed in the V-shaped creel of this machine and a definite number of ends wound evenly on a warper's beam, which is sent to the dressing room.

DRESSING.

The cylinder dressing machine, the one most largely used in linen mills, has no cylinder, and gets its name from the cylindrical brushes that revolve and brush the yarn as it passes over them. The machine is made double: warpers' beams containing the required number of ends are placed in supports at each end and the threads all meet in the middle and are wound on the same loom beam. Each sheet of yarn passes through a dressing trough containing the size mixture,

then under a roller which keeps it down upon a revolving brush; the latter, turning against the course of the yarn, helps to lay the fiber and level the dressing. It then passes over a steam chest containing a quick-running fan that forces air through the yarn to dry it, and in some cases it is subjected to the action of a brush saturated with melted tallow. Then it passes over the measuring roller, to which is attached the color brush for marking the yarn at the end of each cut, and winds evenly with the opposite sheet upon the loom beam. These beams are drawn in by girls with reed hooks that draw the threads through reed and heddles, and are then sent to the loom.

Various substances are used for dressing the yarn, such as flour, farina, starch, sago, and Irish moss, and each mill has a size mixture that it considers best for its particular work. Tallow is the usual softener and zinc chloride or chloride of magnesium the most usual deliquescents, these being even more essential in flax than in cotton sizing, as dressed linen yarn is more brittle and more quickly affected by a variation in the atmosphere. If the cloth is to be sold in its woven condition it is sometimes weighted considerably, but in most cases it goes to the bleach field, and the increase in weight due to size, which is used only for strengthening the warp and enabling it better to withstand the chafing of the reed and heddles, is 8 to 10 per cent.

WEAVING.

In the Irish weave sheds one finds both underpick and overpick looms. Some seem to prefer one and some the other, but the underpick is much more in evidence in Ulster than in Lancashire. Many mills prefer it as giving a sharper pick with less jar of the loom frame and as being cleaner. The spindle on which the picker of the overpick loom moves must be oiled frequently, and if this is not carefully done too much oil gets on, and it is thrown about by the action of the picker arm and is liable to spot the cloth. This can not occur on the underpick. The pickers used for the two types of loom are of quite different patterns; those required for the overpick loom are almost invariably of buffalo hide, while the underpick loom pickers are of cowhide. Automatic looms are little used in the linen trade, and those in use are mainly on union cloths with cotton warps.

Looms on fine linens use self-acting temples, but in weaving coarse linens, such as canvas and heavy sheeting, they are frequently omitted; while in weaving wide cloths and damasks hand temples are very common. The hand temple consists of two wooden strips which are fitted together, very often with a hinge, and which have sharp spikes, leather protected, at their outer and broader ends. These spikes are stuck in the cloth near the selvages and hold it out to width; when a short length has been woven they are pulled up and moved forward nearer the fell. (Fig. 6.)

Generally speaking, linen cloths are figured as shrinking from 5 to 10 per cent from the loom to the finishing state, 40 inches in the reed usually yielding 38 inches loom state and 36 inches finished, while a similar texture 80 inches in the reed usually yields 77 inches loom state and 74 to 75 inches finished. Of course this is rather general, as the actual shrinkage depends on the weave or interlacing of the warp with the weft, the picks per inch, the size of the yarns,

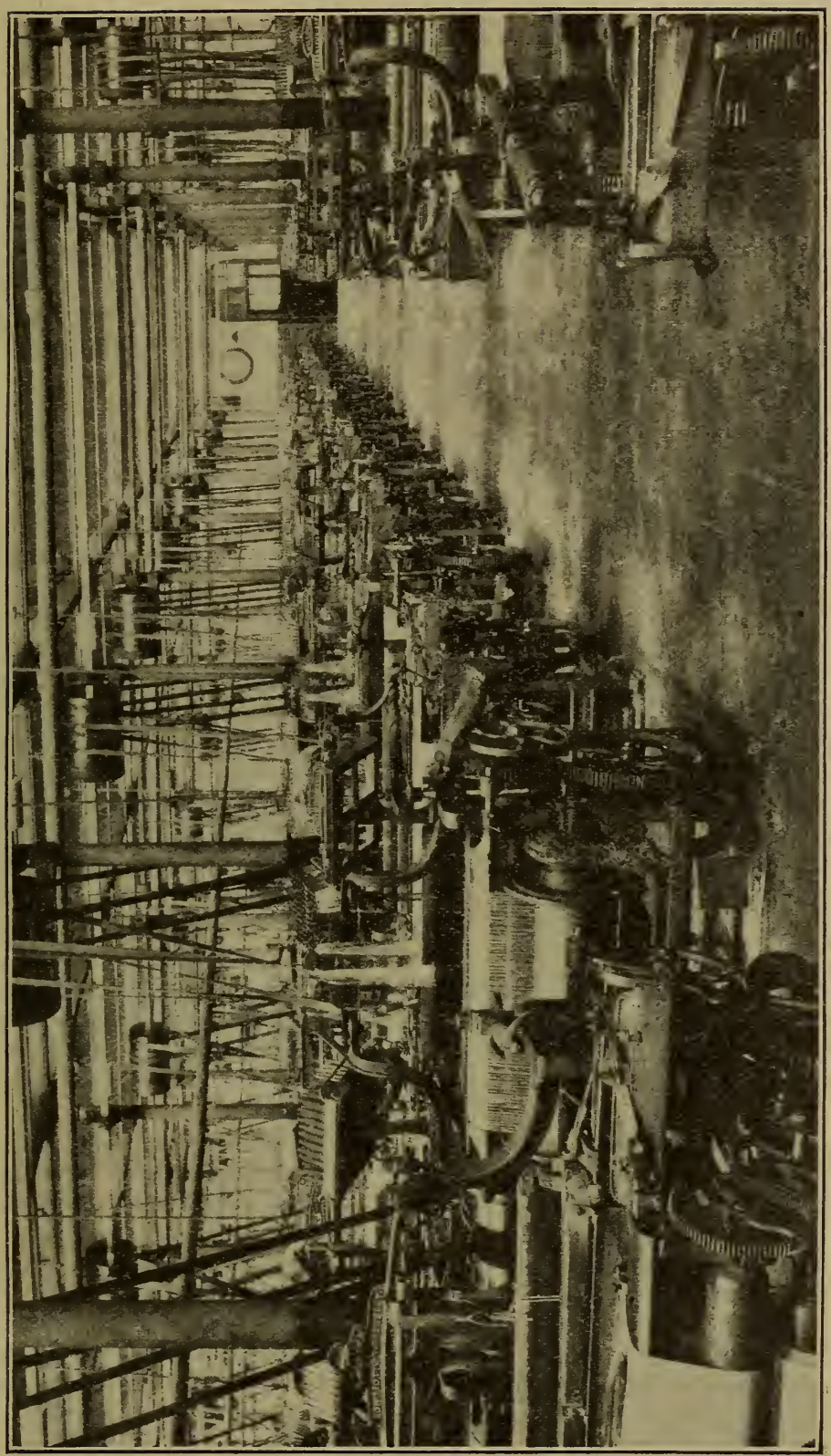

FIG. 6.—Linen weaving mill.

and the tension put on the warp during weaving and finishing. To allow for contraction, the warp that is laid in the dressing machine must be considerably longer than the piece of cloth it is desired to produce; but the finishing processes tend to decrease the contraction in length and increase the contraction in width, as compared with the condition of the cloth as it comes from the loom.

Linen yarn is much more brittle than cotton yarn and more affected by atmospheric changes, and owing mainly to this lack of elasticity linen looms can not be run at the high speeds customary with cotton looms. In Lancashire, plain cotton looms with 40-inch reed space run at 200 picks per minute and over. In Ulster, plain linen looms with 40-inch reed space are usually considered to run 165 picks per minute, but in practice many do not attain this, while the widest looms, which are about 120 inches in width, run at only 80 picks per minute.

METHOD OF STATING CONSTRUCTION.

The construction of cotton cloth, the sley and pick, is usually stated in ends per quarter inch in England and in ends per inch in the United States. In the flax and jute trades the systems, or scales, for showing the spacing of the warp and weft are much more cumbersome and antiquated.

The sett of the warp threads in linen manufacture is variously stated, but for the Irish linen trade the scale most generally adopted is based on the number of hundreds of splits in a 40-inch reed, sleyed two ends in a split. Thus an 8°° linen fabric means that there are 800 splits or 1,600 threads in 40 inches of the reed, a 10°° line fabric means that there are 1,000 splits or 2,000 threads in 40 inches of the reed, etc.; this is irrespective of the actual width of the cloth. For finer sorts, in which there may be actually three, four, or more threads through each dent or split, the sett would increase pro rata. Thus, the usual sett of a fabric woven in a 10°° reed 3 threads in a dent would be $\frac{1000\times3}{2}=15°°$ sett.

The shots, or picks, put into the cloth in Irish linen weaving are reckoned by an equally cumbersome system. This pick scale is reckoned on the number of picks, or shots, under a 37-inch glass, by which is meant a pick glass covering thirty-seven two-hundredths (0.185) of an inch.

As will be seen from the weavers' wage scales following, the construction of Irish linens is frequently expressed by the contracted method of 8/9, 9/10, etc. If a weaver is paid 25d. for weaving a 92-yard cut of 38-inch green linen 8/9, it means that he is working on cloth that is woven through a 8°° reed, 40-inch scale (800 splits or 1,600 warp ends in the standard reed width of 40 inches) and having 9 shots on the 37/200 glass. Such cloth has 40 warp ends per inch (1,600 divided by 40) in the reed, while the picks inserted are equivalent to 48.6 (9 divided by 37/200) per inch. The construction of cotton cloth is stated in terms of ends per quarter inch or inch in the gray or finished condition, while the Irish linen scale shows only the fineness of the reed and the picks inserted in arbitrary distances.

The bulk of the Irish linen cloth is sold in the bleached and finished condition, and after weaving cloths are shipped to the bleach

fields, which, from the nature of their work, are necessarily located in the country away from the smoke and dirt of the city and in proximity to a good supply of water and to grassy fields.

BLEACHING AND FINISHING.

Bleaching has always been an important part of the linen industry, and the bleach fields of Ireland, owing partly to the climate and partly to the inherited skill of the workers, are considered the best in the world. The Irish bleach is unexcelled and grassing can be carried on in Ireland the year round, so that a considerable quantity of linen is yearly sent there from Belgium, France, and Germany to be bleached and returned.

Linen bleaching is a much more severe and tedious operation than cotton bleaching, owing to the greater amount of impurities contained in the flax fiber and its hard, impermeable nature. Cotton bleaching usually takes only a day or two, while linen bleaching takes about three weeks, and for some classes of goods considerably longer. The chief difficulty in bleaching flax lies in the brown substances, known as pectin bodies, contained in the fiber, which can not be destroyed by the unaided action of bleaching powder and require the assistance of the grass-bleaching process.

In old days bleaching was most primitive; the linen was boiled in lye made from burned seaweed, spread out in the fields to the action of the sun, air, and rain, then steeped in buttermilk, washed in pure water, and finished up. The process took some six months, but the bleached linen retained a much greater proportion of its strength than to-day, when the demand for a whiter finish and the increasing cost have necessitated greater use of chemicals and a shortening of the grassing process. It is a very common complaint to-day among housekeepers that linens are not so strong as formerly. No doubt, this is largely true, and it is due to the necessity of carrying the bleach farther to get the pure whiteness now so admired, and to the shortening of the process and greater use of chemicals, which increases the danger of tendering or rotting the fiber. While the bleachers admit this, they assert that much of the tendering is due to abuse the linen receives in modern laundries, which use various chemicals.

MODERN BLEACHING METHODS.

The modern method of bleaching linen in Ireland, as described by the head of one of the largest bleacheries, is as follows: The pieces of linen as they are received from the factory at the bleachery in the country are first marked at one end with red thread for identification. The mark shows the owner, weight, and cloth particulars and is written in with a sewing machine, though some are now experimenting with a quicker process using indelible ink. These pieces, usually 140 in number, are stitched together end to end into one piece of over 10,000 yards. This is called a pot, and the value of a pot runs into thousands of dollars. The pot of cloth is first passed through a solution of lime into the boiling pot, and there boiled for

8 or 10 hours. It is then drawn through a tank of water. The webs are unsewn and each one is bundled separately. They are washed in the wash mills with pure water for an hour, then steeped in a sour of dilute hydrochloric acid to convert the residue of the lime into a soluble salt; washed again in the mills and boiled in soda lye, which combines with the waxes and fats in the fiber and makes them into soap and hence removable; washed again, put on the grass for some days, boiled again in lye, washed, put on the grass, rubbed in soap and water, boiled in lye, washed, put on the grass, and so on, this process of alternate boiling, washing, and grassing being repeated several times, either in the same way or with variations according to the quality of the goods and the degree of whiteness desired.

Apart from the repetition of the various operations and the recourse to grassing, the process of linen bleaching differs from that for cotton in that the goods are kept in motion during the treatment in the chemicking bath, and are subjected to friction between two fluted boards in order to get rid of particles of adherent brown matter.

As soon as the linen is considered sufficiently boiled the whitening process is begun by the use of bleaching powder, or dip, in which the cloth is left overnight. It is washed, treated with weak sulphuric acid, and boiled again with soda lye, this process being repeated until the cloth is found to be of a proper whiteness. The webs are once more stitched together and the process of finishing begins. The cloth is breadthed, passed through a water mangle between rollers which leave just the proper moisture for taking starch, and then into and through a tank filled with a mixture of blue and starch, after which it is passed over heated rollers to dry it. The webs are once more unsewn; they are then put on the beetling beams and beetled for 4 or 5 hours, turned on the beams and beetled for another 4 or 5 hours, and so on until they have had 30 to 60 hours of beetling. They are then aired, stretched to the full width, and calendered. This completes the work of the bleacher, and the whole occupies from 3 weeks for common goods up to 6 and in many cases 8 to 12 weeks for fine goods bleached to the highest degree of purity.

For a long time the bleach fields were in operation only from March to September, but it was found that grassing could be carried on the year round, as a slight frost does not injure the goods, and only for very short periods is work interrupted by the weather. This gives Ireland a considerable advantage over the bleach fields of the Continent. (Fig. 7.)

BEETLING PROCESS—DYEING AND FINISHING.

The beetling process is a most important one in the finishing of linen and imparts to these fabrics their highly prized gloss. It is a stamping process, and the stamps consist of a row of smooth, square-ended wooden rails which rise and fall with a bouncing action on the slowly revolving drum of linen. The lifting cams are mounted spirally on a wooden shaft, and as this revolves each cam in turn hits against a wooden projection on one of the stamps, lifting the stamp

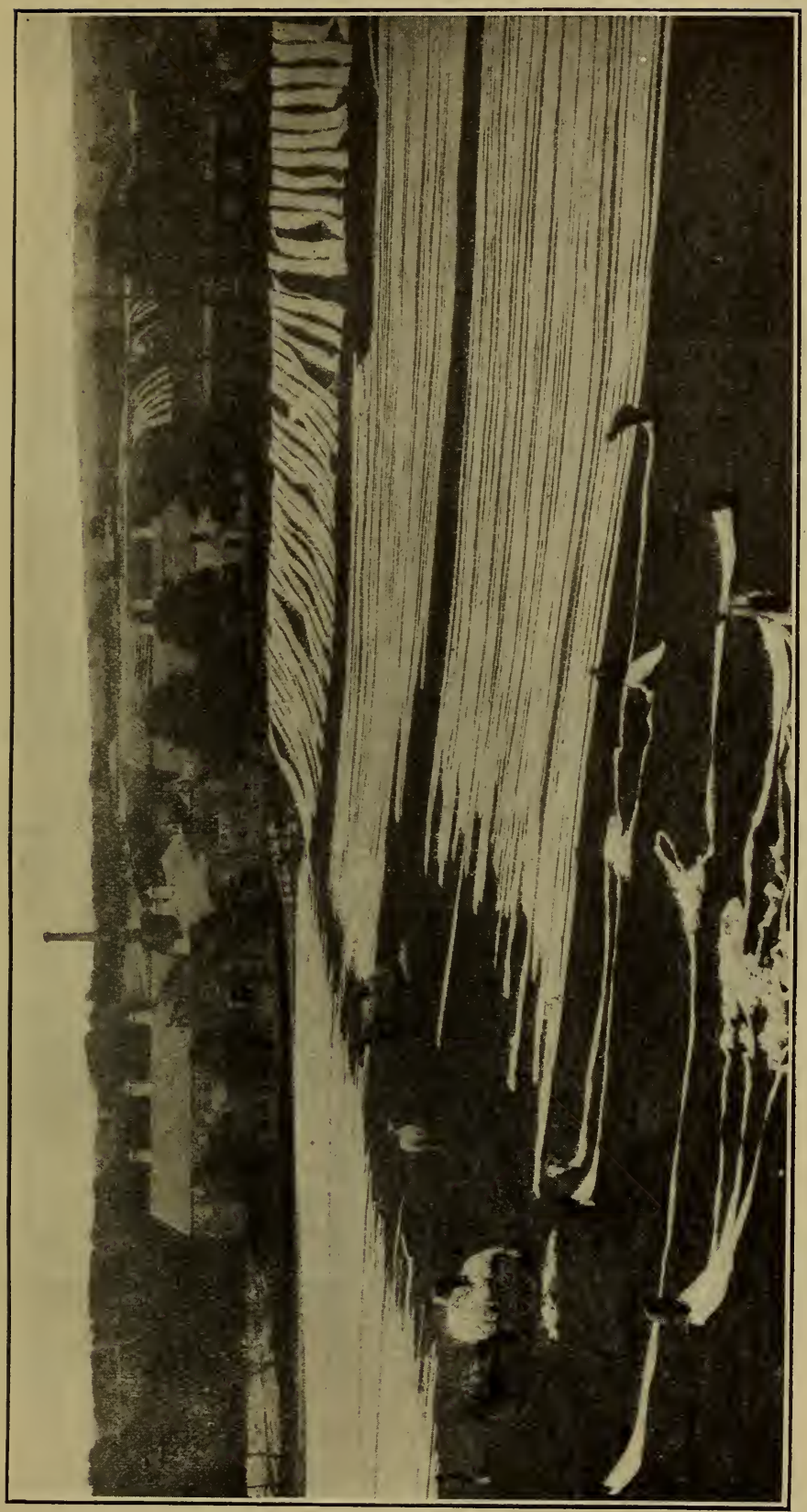

FIG. 7.—The world's largest bleach field.

vertically and then letting it fall. The cams striking the pins and the stamps bouncing on the hard rolls of cloth make a continuous roar. In some cases the stamps are fastened to metallic springs, and these stamps are more productive in quantity, but not in quality. In the calenders the linen receives its final touch, and these have rollers of brass, wood, rubber, etc., for giving various finishes.

The bleach mills usually also dye and finish, and most of them are equipped with the best machinery. The rooms containing the dye vats usually have overhead ducts bringing in warm air. In other countries, where the mills attempt to remove the damp steam arising from the vats by suction fans, one is frequently not able to see across the room on account of moisture, but the system here used of introducing warm air and thereby absorbing the moist steam as created gives a clear atmosphere and much better working conditions.

The bleach mills handle cotton as well as linen, the bleaching processes, of course, being different; and quantities of cotton goods are shipped from Manchester to Ulster and there bleached, dyed, or finished and put up ready for shipment and returned to the manufacturers in Manchester.

BLEACHING ASSOCIATION.

Linen bleaching is not only a tedious but a risky business, for if not carefully watched the cloth is liable to be ruined at almost any stage of the process. The bleachers claimed that it had not been sufficiently remunerative and a few years ago formed in Ulster a close association to regulate prices and terms.

The members of the association are John Adams & Co. (Ltd.), Banford Bleach Works Co. (Ltd.), The Bleachers' Association (Ltd.), Carey, McClellan & Co. (Ltd.), Anthony Cowdy & Sons, William Ewart & Son (Ltd.), Dunadry Bleaching Co. (Ltd.), Frazer & Haughton (Ltd.), Glen Printing & Finishing Co. (Ltd.), Wm. Haig & Sons, S. J. Herd & Co., Inver Bleach & Dye Works (Ltd.), Kilwee Bleaching Co. (Ltd.), Wm. M. Kirk & Partners (Ltd.), Kirkpatrick Bros. (Ltd.), Lambeg Bleaching, Dyeing & Finishing Co. (Ltd.), Lisnafillan Bleaching, Dyeing & Finishing Co. (Ltd.), Lumsden & Mackenzie, James Burt-Marshall (Ltd.), J. & G. Marshall, R. & D. Martin, James Murland (Ltd.), H. J. McBride & Sons (Ltd.), Jas. McInnes & Sons (Ltd.), Old Park Print Works Co. (Ltd.), J. N. Richardson, Sons & Owden (Ltd.), Wm. Smyth & Co. (Ltd.), Ralph W. Stewart & Co., Sullatober Bleaching & Print Works Co. (Ltd.), Uprichard & Lindsay (Ltd.), J. T. & H. Uprichard, Walkerton Bleaching Co. (Jas. Livingston), Whiteabbey Bleaching Co. (Ltd.), Whitewell Finishing Co., York Street Flax Spinning Co. (Ltd.).

There follows the price list of this association, issued August 20, 1913, effective January 1, 1913.

REVISED PRICE LIST FOR BLEACHING AND FINISHING LINEN AND OTHER GOODS.

NOTE.—This list applies to all goods received for treatment on and after January 1, 1913. The prices in this list are subject to a discount of 5 per cent, except for damask, diaper, canvas, and cambric goods, which are net.

GREEN YARN POWER LOOM LINENS AND UNIONS.

Width, in inches.	Unions not exceeding 16°° and weighing, per 100 square yards, not over—				Linens not exceeding 16°° and weighing, per 100 square yards, not over—			
	32 lbs.	38 lbs.	44 lbs.	50 lbs.	32 lbs.	38 lbs.	44 lbs.	50 lbs.
	Pence.	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*
Not over 25	1/2	5/8	3/4	7/8	5/8	3/4	7/8	1
Over 25 and not over 30	9/16	11/16	13/16	15/16	3/4	7/8	1	1 1/8
Over 30 and not over 35	5/8	3/4	7/8	1	13/16	15/16	1 1/16	1 3/16
Over 35 and not over 39	11/16	13/16	15/16	1 1/16	7/8	1	1 1/8	1 1/4
Over 39 and not over 43	15/16	1 1/16	1 3/16	1 5/16	1 1/8	1 1/4	1 3/8	1 1/2
Over 43 and not over 48	1 1/16	1 3/16	1 5/16	1 7/16	1 1/4	1 3/8	1 5/8	1 3/4
Over 48 and not over 54	1 5/16	1 7/16	1 9/16	1 11/16	1 1/2	1 5/8	1 7/8	2 1/8
Over 54 and not over 58	1 9/16	1 11/16	1 13/16	2 1/16	1 3/4	1 7/8	2 1/8	2 3/8
Over 58 and not over 68	1 3/4	1 7/8	2	2 1/4	1 7/8	2	2 1/4	2 1/2
Over 68 and not over 77	2	2 1/8	2 3/8	2 5/8	2 1/8	2 1/4	2 1/2	2 7/8
Over 77 and not over 86	2 1/4	2 3/8	2 3/4	3	2 3/8	2 1/2	2 3/4	3 1/4
Over 86 and not over 98	2 5/8	2 3/4	3 1/8	3 1/2	2 3/4	2 7/8	3 1/4	4
Over 98 and not over 108	3	3 1/4	3 5/8	4 1/4	3 1/4	3 1/2	4	5
Over 108 and not over 117	3 1/2	3 3/4	4	4 3/4	4	4 1/2	5	6

17°° and upward not exceeding 48 inches, 1/8d. per yard extra; not exceeding 77 inches, 1/4d. per yard extra; not exceeding 117 inches, 1/2d. per yard extra.

4/4 BOILED YARN LINENS.

	Pence per yard.	
	Up to and including 20°°.	Above 20°°.
Light power loom:		
Square and under square	1 1/8	1/4d. per yard extra.
One shot over square	1 1/4	
Two shots over square	1 3/8	
Hand loom "Ballymenas"	1 1/4	
Light medium and Continental linens	1 1/2	1/2d. per yard extra.
Medium linens	1 7/8	
Heavy mediums	2 1/4	

All 7/8 linens not exceeding 34 inches wide, 1/8d. per yard less than 4/4; all 3/4 linens not exceeding 30 inches wide, 1/4d. per yard less than 4/4.

As to the first three items in the preceding table, all 9/8 linens not exceeding 43 inches and 5/4 linens not exceeding 48 inches will be charged 1/4d. and 1/2d. per yard, respectively, more than the above prices.

For definitions of light power loom, light medium, medium, and heavy medium, see scale on page 57.

Fractions of a shot will be treated as one shot.

4/4 INTERLININGS.

Green yarn linen, 2 1/2d. per pound. Boiled yarn linen, 3d. per pound. Green warp and boiled weft or vice versâ, 2 3/4d. per pound. Union interlinings, 2 1/4d. per pound. No linens or unions over 9°° taken as interlinings.

Light Boiled Yarn Linens for Embroidery Finish.

Note.—Confined to 13°°, 14°°, 15°°, and 16°°; not exceeding 33 pounds per 100 square yards.

Width, in inches.	Pence per yard.	Width, in inches.	Pence per yard.
Not over 29	5/8	Over 58 and not over 68	2
Over 29 and not over 34	7/8	Over 68 and not over 77	2 3/8
Over 34 and not over 38	1	Over 77 and not over 86	2 3/4
Over 38 and not over 43	1 1/8	Over 86 and not over 98	3 1/4
Over 43 and not over 48	1 1/4	Over 98 and not over 108	4
Over 48 and not over 54	1 1/2	Over 108 and not over 117	5
Over 54 and not over 58	1 3/4		

Boiled Yarn Pillow Linens and Sheetings.

Width, in inches.	Not exceeding 12°° and weighing per 100 square yards not over—						13°° to 16°° and weighing—			Over 16°°.
	35 lbs.	40 lbs.	45 lbs.	50 lbs.	55 lbs.	60 lbs.	37 lbs.	43 lbs.	Over 43 lbs.	
	d.	d.	d.	d.	d.	d.	d.	d.	d.	d.
Not over 25	3/4	1	1 1/4	.....	.....	.....	.....	.....	.....	.....
Over 25 and not over 29	7/8	1 1/8	1 3/8	.....	.....	.....	.....	.....	.....	.....
Over 29 and not over 34	1	1 1/4	1 1/2	1 3/4	2	2 1/4	1 1/8	1 1/2	1 7/8	2 1/8
Over 34 and not over 38	1 1/8	1 3/8	1 5/8	1 7/8	2 1/8	2 3/8	1 3/8	1 5/8	2 1/8	2 3/8
Over 38 and not over 43	1 1/4	1 1/2	1 3/4	2	2 1/4	2 1/2	1 1/2	1 3/4	2 1/4	3 1/4
Over 43 and not over 45	1 3/8	1 5/8	1 7/8	2 1/8	2 1/2	2 3/4	1 3/4	2	2 3/4	3 1/2
Over 45 and not over 48	1 1/2	1 3/4	2	2 1/4	2 3/4	3	1 3/4	2	3	4
Over 48 and not over 50	1 3/4	2	2 1/4	2 1/2	3	3 1/4	1 3/4	2 1/2	3 1/2	4
Over 50 and not over 54	1 7/8	2 1/8	2 1/2	2 3/4	3 1/4	3 1/2	2 1/2	2 1/2	4 1/2	4 1/2
Over 54 and not over 59	2	2 1/4	2 3/4	3	3 1/2	3 3/4	2 1/2	3	5	5
Over 59 and not over 68	2 1/4	2 1/2	3	3 1/2	4	4 1/2	3	3 1/2	6	6 1/2
Over 68 and not over 77	2 1/2	3	3 1/2	4	4 1/2	5	3 1/2	4	6	7 1/2
Over 77 and not over 87	3	3 3/4	4	4 1/2	5 1/2	6	4 1/2	5	7	8 1/2
Over 87 and not over 98	3 1/2	4 1/4	5	5 1/2	6 1/2	8	5	6	8	9 1/2
Over 98 and not over 108	4	4 3/4	6	6 1/2	7 1/2	10	6	7 1/2	9	12
Over 108 and not over 118	4 1/2	5 1/2	7	8	9	11	7	9	10	14
Over 118 and not over 126	6	6 1/2	8	9	10	12	9	11	12	17
Over 126 and not over 135	8	8 1/2	10	11	12	14	11	13	14	20
Over 135 and not over 153	9	11	12	14	15	18	14	16	18	24

The prices above quoted are per yard.

These prices will be charged for 9°° and 10°° three pounds heavier than above weights. The above prices apply to all goods of this class the yarns of which (warp or weft, or both) have been boiled or treated in any way.

Tubular linens and unions (green, boiled, or bleached yarn), 33⅓ per cent extra.

Damasks—Power Loom.

	Net price per square yard.
	Pence.
Cotton damask	1
Power-loom light linen damask, under 4½ ounces per square yard (finished), and all union damasks	1 1/8
Power-loom medium linen damask, over 4½ ounces per square yard (finished), counting under 165 threads per square inch (gray)	1 1/4
Power-loom fine linen damask, over 4½ ounces per square yard (finished) and 165 threads and upward per square inch (gray):	
Not over 77 inches	1 1/2
Over 77 and not over 96 inches	1 5/8
Over 96 and not over 115 inches	1 7/8
Over 115 inches	2 1/4
Power-loom medium linen damask napkins, not over 30 inches wide, over 4½ ounces per square yard (finished), and under 200 threads per square inch	1 1/4
Power-loom fine linen damask napkins, not over 30 inches wide, over 4½ ounces per square yard (finished), and 200 threads and upward per square inch	1 1/2

Fine linen crest, lettered and badged goods, ¼d. per square yard extra.

Damasks—Hand Loom.

	Net price, per yard.		Net price, per yard.
Double damask:	*s.* *d.*	Double damask—Continued.	*s.* *d.*
4/8 not over 18 inches	.. 1	8/4 over 68 and not over 77 inches	.. 4
5/8 over 18 and not over 24 inches	.. 1⅛	9/4 over 77 and not over 86 inches	.. 5
3/4 over 24 and not over 29 inches	.. 1¼	10/4 over 86 and not over 98 inches	.. 6
7/8 over 29 and not over 34 inches	.. 1⅜	11/4 over 98 and not over 104 inches	.. 7
4/4 over 34 and not over 39 inches	.. 1⅞	12/4 over 104 and not over 115 inches	.. 8
9/8 over 39 and not over 44 inches	.. 2¼	13/4 over 115 and not over 125 inches	.. 10
5/4 over 44 and not over 49 inches	.. 2¾	14/4 over 125 and not over 136 inches	1 0
6/4 over 49 and not over 58 inches	.. 3	16/4 over 136 and not over 154 inches	1 6
7/4 over 58 and not over 68 inches	.. 3¼	20/4 over 154 and not over 190 inches	2 0

Single damask, 1¼d. per square yard.

Damask from white yarn to Barnsley silver, or under white finish, 1d. per square yard.

Mercerized cotton damask, 1¼d. per square yard.

Diapers.

Linen, 1⅛d. net per square yard. Union, 1d. net per square yard. Cotton, ⅝d. net per square yard.

Linen Handkerchiefs.

Hand loom.—18-inch, 3¾d. per dozen; 20/20¼-inch, 4d. per dozen; 21/22¼-inch, 4½d. per dozen; 24-inch, 5d. per dozen; 26-inch, 6d. per dozen; 28-inch, 7d. per dozen.

Power looms and unions, ¼d. per dozen less than foregoing.

	18 inches.	20¼ inches.	22¼ inches.	24 inches.	26 inches.	28 inches.
	Pence.	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*
Refinishing linen handkerchiefs, per dozen	1½	1½	2	2¼	2¾	3
Linen handkerchiefs returned to be made rough for printing, per dozen	1	1	1½	1¾	2	2¼
If rough breadthed, do	1½	1½	2	2¼	2¾	3

Goods bleached rough for printing are subject to an extra discount of 20 per cent.

Linen handkerchiefs taken from finished stock and delivered rough, not breadthed, 6d. per piece extra.

Bleached Yarn Linens and Unions.

Width, in inches.	Pence per yard.	Width, in inches.	Pence per yard.	Width, in inches.	Pence per yard.
25	½	48	1¼	77	2½
32	⅝	50	1⅜	86	3
38	⅞	53	1½	96	4
43	1	57	1¾	108	5
45	1⅛	68	2	117	6

Cambric and Union Cambric Handkerchiefs.

Size, in inches.	Bleaching and finishing.	Finishing without guarantee.	Rough for printing.	Bleached and breadthed for printing.
	Pence.	*Pence.*	*Pence.*	*Pence.*
Not over 14.....per dozen..	3	1½	1½	1¾
Over 14 and not over 17.....do....	3¾	1¾	2	2¼
Over 17 and not over 20.....do....	4¼	2	2¼	2½
Over 20 and not over 23.....do....	4¾	2½	2½	2¾
Over 23 and not over 26.....do....	5¼	2¾	2¾	3
Over 26 and not over 28.....do....	6	2¾	3½	4
Over 28 and not over 30.....do....	7	3	4	5
Over 30 and not over 33.....do....	10	3½	6	7
Over 33 and not over 36.....do....	12	4	10	12

Prices quoted in table are net.

Two in width, ⅜d., and three in width ½d. per dozen less.

Plain Cambric, Corded Plains, Sheer Plains, Cords, Union Cambrics, and Sheers.

Width, in inches.	Rough for printing.	Bleached and breadthed.	Close hemstitch finish without beetling.	Bleached and beetle finished.
	Pence.	*Pence.*	*Pence.*	*Pence.*
Not over 28.....per yard..	3/8	1/2	9/16	5/8
Over 28 and not over 34.....do....	1/2	5/8	11/16	3/4
Over 34 and not over 38.....do....	5/8	3/4	13/16	15/16
Over 38 and not over 42.....do....	3/4	7/8	15/16	1 1/8
Over 42 and not over 45.....do....	3/4	1	1 1/16	1 1/4
Over 45 and not over 50.....do....	7/8	1 1/8	1 3/16	1 3/8
Over 50 and not over 54.....do....	1	1 1/4	1 5/16	1 1/2
Over 54 and not over 56.....do....	1 1/8	1 3/8	1 7/16	1 5/8

Prices quoted in table are net.

Boiled yarn lawns to be ⅛d. per yard more than the plain cambric lists.

Corded plains, with a cross border, 1/16d. per yard more than the plain-cambric list.

No risk taken save as to strength and color.

Dip supplied to customers to be charged 2s. per bottle net.

Bleached plains, prepared for printing, 27 inches wide, ¼d. per yard; 34 to 44 inches, ⅜d. per yard; over 44 inches, ½d. per yard.

Prints up to 34 inches, starched, breadthed, and calendered, 15d. per piece; over 34 inches, 18d. per piece.

Goods ordered and finished with hemstitch finish and subsequently changed to beetle finish shall be charged the original hemstitch-finish price and the difference in price between hemstitch finish and beetle finish plus 1/16d.

Plains delivered bleached rough and then returned for beetle finish: Up to 34 inches, ¼d. per yard; over 34 and not over 42 inches, ⅜d. per yard; over 42 inches, ½d. per yard.

Plain Cambrics, Cleared and Refinished.

Beetle finish, up to 34 inches wide, ⅜d. per yard; over 34 and not over 42 inches wide, ½d.; over 42 inches wide, ⅝d.

H. S. finish, up to 34 inches wide, ¼d. per yard; over 34 and not over 42 inches wide, ⅜d.; over 42 inches wide, ½d.

Linen and Union Canvas.

Not exceeding 28 inches wide, ⅝d. net per yard; over 28 and not over 34 inches wide, 11/16d. net per yard; over 34 inches wide, 13/16d. net per yard.

Prices for Refinishing, Change of Finish, Etc.

	39 inches and under.	40 to 58 inches.	59 to 76 inches.	77 to 96 inches.
	Pence.	*Pence.*	*Pence.*	*Pence.*
Linens and unions previously finished to instructions and subsequently changed to any different finish charged extra, per yard	1/8	1/4	1/2	1 1/4
Linens and unions returned to bleacher for change of finish, per yard	1/4	3/8	3/4	1 1/2
Linens and unions cleaned and refinished ....per yard..	3/8	1/2	7/8	1 5/8
Linens and unions returned for refinishing if not bleached at the green to which they are returned ....per yard..	1/2	5/8	1	1 3/4

4/4 linen and unions: High button finish, ½d. per yard extra; refinished, high button finish, ⅝d. per yard; cleared and refinished, high button finish, ¾d. per yard; bleached rough for printing, ⅛d. per yard less than finished price.

For all goods which, in the absence of any instructions for finishing, have to be dried out or held over to await instructions an additional charge will be made as follows: 39 inches wide and under, ⅛d. per yard; 40 to 58 inches wide, ¼d. per yard; 59 to 76 inches wide, ½d. per yard; 77 to 96 inches wide, 1¼d. per yard.

Goods returned "at width" for crisping to be charged 4d. per piece.

Goods washed and beetled, ½d. per square yard; shrunk and beetled, ⅜d. per square yard; shrunk only, ¼d. per square yard; beetled only, ¼d. per square yard.

Lapping and papering linens and sheetings, 5d. per piece of 50 to 60 yards; 3d. per half piece. Where packing cases are supplied they will be charged at 3½d. per superficial foot.

4/4 Boiled Yarn Linens.

[Scale referred to on page 53.]

Warp construction.	Weight not exceeding per 100 square yards.			
	Light power loom.	Light medium.	Medium.	Heavy medium.
	Pounds.	*Pounds.*	*Pounds.*	*Pounds.*
900	.....	36	41	.....
1000	.....	35	40½	44
1100	.....	34½	39½	.....
1200	.....	33½	38½	42
1300	.....	33½	37	41
1400	.....	32	36½	38½
1500	29½	31½	35½	38½
1600	28½	30	34	38½
1700	28½	30	32½	36
1800	28	29	32	35
1900	28	29	31	33½
2000	27	28	30	32½

Terms and Conditions.

All goods covered by the foregoing price list are received on and subject to the following terms and conditions:

1. No responsibility for tendering will be entertained in respect of goods made from bleached yarns.

2. Goods ready for delivery up to and including the 20th of the month shall be paid for in cash, or its equivalent, on the 4th of the following month, whether the customer shall have actually taken delivery or not, and interest at the rate of 5 per cent per annum will be charged on all accounts not so paid.

3. The bleacher will pay the carriage to and from the customer's premises, except in the case of Continental goods, and in respect of those the bleacher will not be liable for or pay carriage, except between his works and the port of landing in Ireland.

4. The bleacher will not be responsible or liable for (a) delay in returning goods from the bleach from whatever cause arising; (b) any damage to goods or claims in respect of color or finish of which written notice shall not have been given to the bleacher within one calendar month from date of delivery.

5. In case of damage for which the bleacher is responsible, no claim shall be made or will be entertained in respect of piece goods where the damages in one piece are five in number, except in the case of damask piece goods, where the damages in any one piece must exceed three in number. No claim for piece goods will be entertained or be provable if the ends be cut off. In all cases the goods alleged to be damaged must be produced to the bleacher for inspection, otherwise no claim can be entertained or enforced, except in the case of damask cloth, napkins, and towels, when the production of the damaged portions, together with the ends, will be sufficient compliance with this condition.

6. Where the goods damaged are to be retained by the bleacher, the damages shall be settled on the basis of the brown prices of the day on which the goods were ready to be delivered.

7. All differences and disputes shall be settled by arbitration, each party naming an arbitrator. Arbitration shall be a condition precedent to any proceedings at law. Each arbitration shall conform to the provisions as to arbitration contained in the common-law procedure amendment (Ireland) act, 1856, or any statutory modification thereof.

8. All goods are subject to a general lien, not only for bleaching and finishing but for all liabilities of the customer to the bleacher, including liabilities which the bleacher may be under to others for the customer.

9. Where the price is calculated on the basis of the square yard, the yard shall be taken as 36 inches brown width and 37 inches lineal.

10. No discounts, allowances, drawbacks, inducements, or gratuities will be given or allowed, either to principals or their agents, employees, or any other person, save the discount provided for by this list.

WAREHOUSE WORK.

As previously noted, flax is grown, retted, and scutched in the country; sent to the town to be hackled, prepared, and spun into yarn in the mill and woven into cloth in the factory; then sent back to the country to be bleached and finished. Finally it is sent to the city warehouse to be ornamented and made up and shipped. The term warehouse, as used in the textile trades of the United Kingdom, does not refer solely to a place of storage, but to a place where goods are prepared for the market in various ways.

In the Belfast warehouses the cloth from the bleach fields is inspected and any defects are remedied. Cloth to be shipped in the piece is lapped or folded, with or without colored tissue paper interlining, stamped or ticketed, each piece wrapped in glazed paper, and cased and marked for shipment. The cases are well made, usually having a wooden batten around the middle on all four sides and iron ties around the edges at each end. Methods of putting up cloth vary with different classes of goods and the customs of the countries to which they are shipped. Each country not only requires certain makes of cloth, but in shipping the same make the width of the cloth, the number of folds, the kind and color of wrapping paper, the style of tickets, etc., must be such as are in demand there. The width and general make-up of goods for Paris, for instance, may be entirely different from that required in the United States if they are to be salable.

Making up and shipping piece goods constitute only a small portion of the work of the warehouse. Cloth for handkerchiefs, centerpieces, table covers, etc., are torn into the correct sizes and hemstitched, threads drawn, embroidered with initials or designs in white or colors, or ornamented in various ways. In the large warehouses there are rooms full of girls—sometimes hundreds—working sewing machines of the various types employed for different styles of ornamentation; a few of the warehouses also have hand embroidery machines worked by pantograph on the Swiss system.

OUTWORKERS.

In connection with the warehouse system considerable material is given out to be worked at home. This is a very extensive business and no report on the Irish-linen trade would be complete without some reference to it. In finishing and making up linen goods, as in every other stage of production, the industry is one that seems to thrive only with very cheap labor. The rates for outworkers are particularly low. The small pay that most of these people receive and their long working hours, which proved injurious to health and led to neglect of the home by mothers of families (who constitute the majority of the workers), finally became so notorious that in 1911 the British Government appointed a departmental committee to inquire into the conditions of work and methods of payment.

This committee reported in 1912 that, though complete statistics as to their number were lacking, the outworkers evidently exceeded those employed in making up in the factories and workshops. The latest returns from the factories and workshops in the linen trade of Ireland are for 1907, and they showed that the workers in the warehouse, or making-up end of the industry, numbered about 22,000. It was computed that the outworkers in Belfast alone numbered some 3,400, and in Lurgan about 1,400, only estimates being obtained for other centers. Outworkers are to be found not only in Belfast, Lurgan, and Londonderry, but in the neighborhood of Portadown, Newtownards, Maghera, Strabane, Buncrana, Donegal, and a great number of other urban and rural districts throughout Ulster, in some of which outwork is done in almost every cottage.

The outworkers in Belfast are described as widows and spinsters dependent upon the work for their livelihood, married women whose husbands are out of work, and women whose husbands are earning small pay. There are a few in better circumstances who work for pocket money; the larger section do it to supplement small pay. In the country districts they are mainly the wives and daughters of small farmers and agricultural laborers; in some families the women spend part of their time working on the farm and in the fields; in others one or two women devote themselves wholly to sewing or embroidery and the rest are employed out of doors or in housework.

PRINCIPAL PROCESSES IN MAKING UP.

Making-up work in Belfast and neighboring towns consists mainly in the production of linen and cotton household articles, handkerchiefs, and wearing apparel other than ladies' underclothing. The embroidery of these articles is also carried on in Belfast, as well as in numerous country districts in Counties Down, Antrim, Tyrone,

Londonderry, Donegal, and Fermanagh. In the city of Londonderry and in the adjacent districts of Counties Londonderry, Donegal, and Tyrone the work comprises the manufacture of shirts, collars, and ladies' underclothing.

The principal processes in the making-up work are as follows: Broad and narrow hemming, thread drawing, vice folding, paring, hemstitching, top-sewing or overseaming, thread clipping, lace attaching, lace undercutting or clipping, scalloping, nickeling, embroidering, spoking, fancy sewing (drawn-thread work), machine stitching of linen and cotton apparel and household articles, buttonholing, sewing on buttons, collar running and turning. The principal market for much of the Belfast and Lurgan work appears to be the United States.

The method of distributing material to outworkers depends on where they live. In the towns it is usually given out from the warehouse, either to the outworkers themselves or to their children, who carry it home and bring it back when finished. In the country it is distributed by agents from a shop, an office, or some spot where the agent arranges to meet the workers. Employment in the making-up trades is more or less continuous the year round, but the busiest period seems to be that preceding Easter. The handling to which the goods are subjected in the warehouse and in the homes necessarily soils the goods somewhat, so the warehouses maintain complete steam laundries, where the finished work is thoroughly washed, dried, ironed, and prepared for the final folding and packing.

EARNINGS OF OUTWORKERS.

It is estimated that about $1,250,000 is paid in wages annually to workers in the Ulster cottage embroidery industry. The outworkers have no organization of any kind, and the pay is very small, but this work is the sole livelihood of thousands and furnishes a welcome addition to the small family earnings of thousands of others. The committee divides the workers whose cases they investigated into classes earning 1d., 2d., 3d., 4d., 5d., and 6d. an hour. They found extremely few cases of the higher rates being paid. In the thread drawing and machine stitching, for instance, they decided that the largest number of workers earned between 1d. and 2d. an hour, and in thread clipping as earning under 1d. (2 cents) an hour; in embroidery the bulk of the workers earned one of the three lowest rates. Many instances were found of women employed on work the rate of pay for which was such that they could not make a half penny (1 cent) an hour. and their remuneration was less than 15 cents a day. In addition to women and girls it was found that a large number of young children were steadily employed in the homes, chiefly in thread clipping and drawing.

Irish hand-embroidery work is known the world over, but it appeared from the evidence that the hand-embroidery industry in Ulster not only has to face keen competition from machine embroidery made in Irish factories and in Switzerland but from hand embroidery worked in Japan and from Belgian and Japanese drawn-thread work.

No legal action has yet followed the recommendations of the committee, but the resultant publicity has in many instances forced the manufacturers to grant a slight increase in the pay for home work.

OPERATIVES AND WAGES.

Of the 100,475 operatives engaged in the linen industry in the United Kingdom in 1907, the latest year for which complete statistics are available, 67,027 were employed in Ireland. In 1904 it was found that 62,194 out of a grand total of 95,950 were employed in Irish mills. This takes no account of the home workers, of whom no enumeration was attempted. Over two-thirds of these operatives were women and girls. Men formed only about 20 per cent of the total, and most of them were foremen, roughers, sorters, weavers, mechanics, and laborers. A great majority of the weavers are women, though there are proportionately more men weavers in the country districts of Ireland than in the mills in Belfast. The number of half-timers in the industry is steadily decreasing.

In Belfast itself, the census of 1911 showed that a total of 29,626 workers were employed in the linen mills, of whom 6,253 were males and 23,373 females. In the spinning processes 14,049 were employed, of whom 2,736 were males and 11,313 females; in weaving processes, 10,833, of which 1,569 were males and 9,264 females; in other processes, 4,744, of whom 1,948 were males and 2,796 females. Most of those shown as engaged in other processes are employed in warehouse work.

NUMBER OF OPERATIVES.

The total number of operatives in Irish linen mills has been recorded by the Government as follows:

Years.	Operatives.	Years.	Operatives.	Years.	Operatives.
1835	3,681	1862	33,525	1885	61,749
1839	9,017	1868	57,050	1890	64,475
1847	17,088	1870	55,039	1895	66,113
1850	21,121	1874	60,316	1904	62,194
1856	28,753	1878	56,342	1907	67,027

GENERAL AVERAGE OF WAGES.

The manufacture of linen is essentially a low-wage industry, and wages in the linen trade of the United Kingdom average lower than in any other textile trade, not even excepting the much lower-priced jute. The latest figures are those for 1906, which showed that linen operatives averaged 12s., or $2.92, a week, since which time there have been raises in certain sections of the industry that make the present average about 12s. 6d., or $3.04.

In the mills the foremen, enginemen and stokers, general laborers, warehousemen and packers, manglers and calenders, all of whom are men, are paid by time. Tacklers are usually paid by time, with a bonus on the wages earned by the weavers. Some of the men bundlers and driers, dressers, and bleachers are paid by time and some by the piece. The boy fillers, or machine boys on the hackling machines, are also paid by the week. Men roughers and sorters are paid by the piece. Women and girls in the preparing room—line spreaders, tow carders, drawers, back minders, and roving hands—are paid entirely by time. Spinners are paid by time, as are the other women and girls in the spinning room. Reelers and winders are paid by the piece.

Weavers, whether men or women, are always paid by the piece, except in a few instances of special work. In the warehouse the majority of the women and girls are paid by the piece, except in certain cases where the nature of the work makes time payment necessary.

WAGES FOR ROUGHING AND HACKLING.

The first process in the mill is that of roughing. The rougher, an able-bodied man, pulls the flax handful by handful through a hackle of strong vertical teeth to disentangle the fibers and to separate the longer fibers that are to go through the linen processes from the shorter ones that remain as tow. The standard production is considered to be 2 hundredweight, or 224 pounds, per day, and this is paid for by the piece. In Belfast the Government figures showed that roughers in 1886 averaged 18s. 6d. ($4.50) per week and in 1906, 21s. 8d. ($5.27). There is no uniform scale, but the secretary of the flax roughers union stated that the usual Belfast rate is now (1913) 2s. 3d. per hundredweight (55 cents per 112 pounds) for roughing Irish flax, and 2s. per hundredweight (49 cents per 112 pounds) for roughing Baltic and similar foreign flaxes. The ordinary good rougher, he stated, averages about 25s. ($6.08) a week, while those in the country, who are paid a somewhat lower rate, average about 2s. less a week.

In the next process, that of machine hackling, the pieces of flax are disentangled and paralleled and the shorter fibers combed out as tow. A pair of single machines, requiring four machine boys, or a combined machine, requiring only one machine boy, turns off from 3,000 to 6,000 pounds of hackled flax per week of 55½ hours, the production depending on the speed and on the size of the pieces hackled. With four boys the weekly wage for each is usually from 7s. 6d. to 10s. ($1.83 to $2.43), while the one boy on the newer double machine is usually paid from 8s. 6d. ($2.07) to as high as 12s. ($2.92) per week.

SORTERS AND SPREADERS.

The sorters, who do work similar to but finer than the roughers, and who sort the hackled flax into as many qualities or lengths of line as may be required, are always men and they are usually paid by the piece, the rate varying at different mills with the quality of the material. The Government figures showed that Belfast sorters in 1886 averaged 23s. 1d. ($5.62) per week and in 1906, 26s. 3d. ($6.39). The secretary of the hacklers union stated that the ordinary good sorter in his union now counted on making about 30s. 6d. ($8.94) per week, while those in the country made about 29s. ($7.06).

In the preparing room the women who lay the pieces of line on the feed aprons of the spreading machines to form continuous slivers are called spreaders. The spreaders, the drawing-frame tenders and back minders, and the roving hands are all paid by time, and usually receive the same wages, though the spreader is sometimes paid a trifle more than the others if she has to weigh the pieces before putting them on. In Belfast the average wages of preparing-room women were shown by the Government to have been 6s. 10d. ($1.66) in 1886 and 9s. 4d. ($2.27) in 1906. To-day their wages run from 10s. to 13s. ($2.43 to $3.16), but average about 12s. ($2.92) a week.

SPINNING ROOM.

Spinning frames formerly had 85 to 100 spindles a side, but have been increased in length until some now have as many as 170 spindles; speeds also have been greatly increased. Spinners usually run a side, varying from, say, 104 spindles on coarse work up to 170 spindles on very fine work, using wet spinning. Full-time doffers are girls from 12 years of age upward, who work in gangs under a doffing mistress. In some cases there is a layer, whose work is to attach the roving to the spindle, and sometimes there are employed spare hands called piecers, as well as spinners. A child on entering the spinning room may begin as a cager, or basket carrier, and be promoted successively to the rank of doffer, layer, piecer, and spinner. All are paid by the week. The Belfast spinners in 1886 were found to average 8s. 5d. ($2.05) a week and in 1906, 10s. 5d. ($2.54). The ordinary rate is now 11s. to 12s. ($2.68 to $2.92) a week. In one of the very largest spinning mills I found that the doffing mistresses were paid 13s. 9d. ($3.35) a week; half-time cagers, 3s. 3d. ($0.79); full-time doffers, 9s. 3d. ($2.25), and half-time doffers, of course, half as much; layers, 10s. ($2.43); piecers, 11s. ($2.68); spinners, 11s. ($2.68) plus a bonus of 6d. (12 cents) if they lost no time. Half-timers work in the mill and attend school alternate days, but their number is decreasing.

Reelers are paid by the hundred hanks, according to the counts of yarn reeled. In 1886 the Belfast reelers were found to average 8s. 11d. ($2.17), and in 1906, 11s. 3d. ($2.74), but they now average about 12s. ($2.92) a week.

The drying and bundling of the reeled skeins is done by men, some of whom are paid by time and some by piece rates, the former usually receiving about 21s. ($5.11), and the latter making about 27s. 6d. ($5.69) a week.

Of the men employed in the spinning mill the foremen of the hackling room and the foremen of the spinning room receive about the same wages, from 30s. to 45s. ($7.30 to $8.42) a week, according to the work and the size of the mill; the foremen of the preparing room are usually paid slightly less. Mechanics get about 36s. ($8.76) a week, enginemen and stokers from 20s. to 30s. ($4.87 to $7.30), and general laborers from 15s. to 20s. ($3.65 to $4.87).

WEAVING FACTORY.

In the weaving factory tacklers are usually paid by time, with a bonus on the wages earned by the weavers under their care. They usually supervise 50 to 70 looms, the number depending on the kind of loom and the character of the weave shed. In Belfast they make from 30s. ($7.30) up to as high as 60s. ($14.60) a week. Some of the men who rŭn the dressing machines are paid by time and some by the piece, and they make from 36s. to 50s. ($8.76 to $12.16) a week. The yarn is usually received in the weave shed in the form of hanks, and the weft has to be wound onto pirns for the shuttle, while the warp has to be wound onto spools for the beam warper. Dressing is men's work, but winding and warping and drawing in are done by women and girls. Most of the weavers are women, who run two

looms each and are paid by the piece. In Belfast in 1886 women winders averaged 9s. 3d. ($2.25) and women weavers 11s. 6d. ($2.80), while in 1906 women winders averaged 11s. 3d. ($2.74) and women weavers 11s. 6d. ($2.80). The average weekly earnings of both are now about 12s. ($2.92), but this varies considerably with the quality of the work as well as the capacity of the worker.

The following piecework rates for winding, beaming, drawing in, and weaving are those now paid in a representative Belfast mill having between 500 and 1,000 looms (1d.=2 cents):

WEAVING SCALE OF MILL A FOR ROUGHS, ETC., (GREEN AND TREATED) UP TO 32 INCHES WIDE IN 100-YARD PIECES.

Construction.	Pieces.			Bonus.	Hours.
	Four.	Three.	Less.		
	Pence.	*Pence.*	*Pence.*	*Pence.*	
4/4	16	.....	15	.....	10
5/4	16	.....	15	.....	11
4/5	17	.....	16	.....	12
5/5	17	.....	16	.....	13
6/5	17	.....	16	.....	13
5/6	17	.....	16	.....	14
6/6	18	.....	17	.....	15
6/7	.....	19	18	.....	17
7/7	.....	20	19	.....	17
7/8	.....	22	21	.....	20
8/8	.....	23	22	3	20
7/9	.....	24	23	3	23
8/9	.....	25	24	3	23
9/9	.....	26	25	3	23
8/10	.....	27	26	3	26
9/10	.....	28	27	3	26
10/11	.....	30	29	3	28
11/12	.....	32	31	3	30
12/13	.....	34	33	3	33

For cloth 33 to 35 inches wide, add 1d. to the foregoing scale; cloth 36 to 39 inches wide, 2d.; cloth 40 to 42½ inches wide, 3d.; cloth 43 to 46 inches wide, 6d.; cloth over 46½ inches wide, 7d. Split, 3d. extra. All unions and checks, 110 yards, paid at above scale.

WEAVING SCALE OF MILL A FOR DUCKS, ETC., UP TO 33 INCHES WIDE IN 100-YARD PIECES.

Construction.	Pieces.			Hours.
	Three.	Two.	Less.	
	Pence.	*Pence.*	*Pence.*	
8/6	18	.....	17	15
9/6	18	.....	17	15
10/6	19	.....	18	16
8/7	20	.....	19	17
9/7	21	.....	20	18
10/7	21	.....	20	18
11/7	.....	21	20	18
9/8	.....	22	21	19
10/8	.....	22	21	19
11/8	.....	23	22	19
12/8	.....	23	22	20
10/9	.....	24	23	22
11/9	.....	24	23	22
12/9	.....	25	24	22
10/10	.....	25	24	23
11/10	.....	26	25	23
12/10	.....	27	26	24
13/10	.....	27	26	24
11/11	.....	27	26	25

For cloth 33 to 35 inches wide, add 1d. to the foregoing scale; cloth 36 to 39 inches wide, 2d.; cloth 40 to 42½ inches wide, 3d.; cloth 43 to 46 inches wide, 6d.; cloth over 46 inches wide, 7d. Split, 3d. extra. All unions and checks, 110 yards, paid at above scale.

Weaving Scale of Mill A for Green Linens 38 Inches Wide in 92-Yard Pieces.

Construction.	Pieces.		Bonus.	Hours.
	Two.	Less.		
	Pence.	*Pence.*	*Pence.*	
8/9	25	24	3	22
9/10	28	27	3	24
10/11	30	29	3	26
11/12	32	31	3	27
12/13	34	33	3	30
13/14	36	.....	3	33
14/15	39	.....	3	36
15/16	44	.....	3	38
16/17	49	.....	6	40
17/18	55	.....	6	42
18/19	60	.....	6	44
19/20	66	.....	6	46
13/15	38	36	3	35
14/16	.....	41	3	38
15/17	.....	48	3	40
16/18	.....	52	6	42
17/19	.....	58	6	44

Weaving Scale of Mill A for Cambrics 37½ Inches Wide in 85-Yard Pieces.

Construction.	Rate.	Bonus.	Hours.	Construction.	Rate.	Bonus.	Hours.
	Pence.	*Pence.*			*Pence.*	*Pence.*	
10/10	24	3	22	11/12	30	3	29
11/11	28	3	24	12/12½	32	3	30
12/12	31	3	26	12/13	33	3	.....
13/13	34	3	28	13/14	36	3	.....
14/14	35	3	30	14/15	39	3	.....
15/15	40	3	33	15/16	43	3	.....
16/16	44	3	35	16/17	45	6	.....
17/17	48	3	37	17/18	51	6	.....
11/11½	29	3	25				

Cloth 44 inches or more wide, 10 per cent on above scale.

Weaving Scale of Mill A for Boiled Linens 38 to 42½ Inches Wide in 85-Yard Pieces.

Construction.	Rate.	Bonus.	Hours.	Construction.	Rate.	Bonus.	Hours.
	Pence.	*Pence.*			*Pence.*	*Pence.*	
9/10	24	3	22	17/18	57	6	40
10/11	27	3	24	18/19	63	6	42
11/12	30	3	26	19/20	69	6	44
12/13	33	6	28	20/21	75	6	46
13/14	36	6	30	21/22	81	6	48
14/15	39	6	32	22/23	87	12	50
15/16	45	6	34	14/14	36	6	30
16/17	51	6	37	14/14½	37	6	31

Unions (cotton warp and linen weft) 38 inches wide, 100 yards, paid at above scale.

Warp Winding Scale of Mill A.

Yarns.	Rate per 100 hanks.	Yarns.	Rate per 100 hanks.
Linens, green or finished:	*Pence.*	Tows:	*Pence.*
Up to 55s	10	Green	10
If slubbed	12	Treated	11
60s to 75s	11	Dry spun	12
If slubbed	13	Dyed	13
80s and up	12	Cotton:	
If slubbed	14	Gray and white	[1].04
		Colored	[1].05

[1] Per lea per pound.

Weft Winding Scale of Mill A per 100 Hanks.

LINE YARNS.

Number.	Gray.	Gray and slubbed.	Boiled and slubbed.	Dyed.
	Pence.	*Pence.*	*Pence.*	*Pence.*
Up to 22s	18	22	23	24
25s to 65s	17	21	22	22
70s to 75s	18	22	22	.....
80s to 85s	18	22	23	.....
90s to 110s	18	22	25	.....
120s	19	23	25	.....
130s	20	24	27	.....
140s and up	21	25	27	.....

TOW YARNS.

Number.	Green.	Treated.	Dry spun.	Dyed.
	Pence.	*Pence.*	*Pence.*	*Pence.*
Up to 20s	19	20	20	23
22s and up	17	18	.....	21

Cotton, gray and white, 0.05d. per lea per pound; colored, 0.07d. per lea per pound.

Warper's Scale of Mill A.

Ends.	Rate per 1,000 yards.	Ends.	Rate per 1,000 yards.
	Pence.		*Pence.*
Up to 200	$2\frac{1}{4}$	801 to 900	$4\frac{3}{4}$
201 to 300	$2\frac{1}{2}$	901 to 1,000	$5\frac{1}{4}$
301 to 400	$2\frac{3}{4}$	1,001 to 1,050	6
401 to 500	3	Cotton:	
501 to 600	$3\frac{1}{4}$	White	4
601 to 700	$3\frac{3}{4}$	Colored	5
701 to 800	$4\frac{1}{4}$		

Leas 16s, 18s, and 20s, 50 per cent on above scale.

Drawers-in Scale of Mill A.

Drawing in, 8d. per 1,000 splits.
Drawing in and lifting leas, 12d. per 1,000 splits.

METHOD OF COMPUTING WEAVERS' WAGES.

Study of the preceding weaving scales will show that the system used in Irish linen mills differs somewhat from that customary in English cotton or worsted mills, where the price is frequently fixed at so much per pick for some fixed length of warp, width, and type of loom, and where any alteration in the number of picks or in length of warp involves a pro rata change in price.

In the linen mills the management carefully notes the time that it takes to weave each specific fabric, or else calculates the time that it should take, allowing a certain percentage, found from observation of nearly similar goods, for all stoppages and loss of time. The weaver's rate of pay is based primarily on the width and construction of the goods and the kind of yarn used, taking into account its condition, whether green (unbleached), boiled, creamed, half bleached, full bleached, etc. The rate of pay thus fixed, however, is usually based on the weaver getting off a definite number of cuts per loom in the specified time, and if he turns off less than this his rate per piece is reduced, in most cases by a penny. For instance, in mill A a weaver on 38-inch green linens, 8/9 sett and picks, is paid 25d. per 92-yard cut if he turns off at least two 92-yard cuts per loom in 22 hours, but if he fails to get two pieces per loom in this time he is paid only 24d. a cut. In some mills this system is varied by paying the weaver a set price per cut and then adding a bonus if he does it in a specified time. The bonus shown in mill A is for perfect cloth. The system of differential rates—that is, the bonus system—is typical of the Irish mills and is used to insure regular attendance of spinners, winders, etc., by a bonus at the end of the week to all those who have lost no time; to stimulate production by paying winders, etc., a bonus on every shilling earned above a specified amount and weavers a higher rate of pay for reaching a certain output per loom; and to stimulate good work by paying a bonus for perfect cloth. A large though unascertained proportion of the looms in Irish linen mills work on union fabrics made with a cotton warp and linen weft, and as this is easier work the rate of pay is always less than for all-linen goods of the same make.

EQUIVALENT OF IRISH LINEN SCALE IN ENDS PER INCH.

The construction of the goods, the sett and pick, in Irish weaving scales is shown in the contracted nomenclature of 8/9, 9/10, 10/11, etc., which is rather confusing, as it is so similar to the 5/4 (five-quarter), etc., method of describing cloth widths, and is also liable to be mistaken for the English method of showing shillings and pence. As previously noted, 8/9 sett and pick, as used in the Irish linen trade, would mean that the cloth is woven through an 8°° reed, 40-inch scale (that is, 800 splits or 1,600 ends in the standard reed width of 40 inches), and counting 9 shots under a 37-inch glass (9 shots or picks in 37/200, or 0.185, inch).

The following table may be useful in obtaining the equivalent of the Irish linen scale in the more rational system of ends per inch:

Reed.		Picks.	
Irish 40-inch scale.	Equivalent warp ends per inch.	Irish scale, under 37-inch glass.	Equivalent picks per inch.
4°°	20	4	21.6
5°°	25	5	27.0
6°°	30	6	32.4
7°°	35	7	37.8
8°°	40	8	43.2
9°°	45	9	48.6
10°°	50	10	54.1
11°°	55	11	59.5
12°°	60	12	64.9
13°°	65	13	70.3
14°°	70	14	75.7
15°°	75	15	81.1
16°°	80	16	86.5
17°°	85	17	91.9
18°°	90	18	97.3
19°°	95	19	102.7
20°°	100	20	108.1
21°°	105	21	113.5
22°°	110	22	118.9
23°°	115	23	124.3
24°°	120	24	129.7

Thus, an Irish linen rough 4/4, which would be called a 4°° reed cloth with 4 shots per 37-inch glass, would be woven with 20 ends per inch in the reed and with 21.6 picks per inch, while Irish fine linen cambrics 24/24 would be woven with 120 ends per inch in the reed and 130 picks per inch.

WINDING SCALES OF VARIOUS MILLS.

There have been shown the winding, warping, drawing-in, and weaving piecework scales of one large Belfast factory, designated as mill A. There is no uniform scale in force, and an idea of the diversity may be obtained from the scales in force in some other mills.

Winding Scale of Mill B.

Yarns.	Rate per 100 hanks.	Yarns.	Rate per 100 hanks.
WARP.		WEFT—continued.	
Gray:	*Pence.*	Gray—Continued.	*Pence.*
10s to 20s	13	120s to 130s	22
Above 20s	12	140s to 150s	23
Boiled, all leas	12	160s to 170s	26
Bleached, all leas	13	Boiled:	
Colored:		14s—	
14s	15	Not slubbed	17
Above 14s	14	Slubbed	22
WEFT.		40s—	
Gray:		Not slubbed	18
Up to 45s	18	Slubbed	20
45s to 80s	19	90s to 120s, slubbed	26
90s to 110s	21	130s, 140s, and 150s, slubbed	28

Each girl has 20 ryces; no bonus.

WINDING SCALE OF MILL C.

Yarns.	Rate per 100 hanks.	Yarns.	Rate per 100 hanks.
WARP.		WEFT—continued.	
Gray:	*Pence.*		*Pence.*
Up to 90s	11	Colored, all leas	19
Above 90s	12	Boiled:	
Colored, all leas	13	Up to 85s	19
WEFT.		90s to 120s	22
Gray, all leas	18	120s and up	25
White, all leas	19		

Each girl has 20 ryces and 6d. bonus at end of week if she loses no time.

WINDING SCALE OF MILL D.

Yarns.	Rate per 100 hanks	Yarns.	Rate per 100 hanks.
WARP.		WEFT—continued.	
	Pence.	Gray—Continued.	*Pence.*
Gray, all leas up to 90s	11	120s and 130s	24
Boiled, all leas	12	140s and up	27
Colored, all leas	14	Boiled:	
WEFT.		Up to 85s	23
Gray:		90s	24
Up to 85s	21	100s and 110s	26
90s, 100s, and 110s	23	120s and 130s	27

Each girl has 20 ryces and is paid a bonus of 1d. on every shilling earned per week above 6s.

COMPARISON OF WINDING SCALES IN COUNTRY MILLS.

Following is a comparison of winding scales in two country mills working on fine goods. While these two mills were on the same general quality of material, the winders in mill F averaged about 2s. more per week than the winders in mill E.

Yarns.	Rate per 100 hanks		Yarns.	Rate per 100 hanks.	
	Mill E.	Mill F.		Mill E.	Mill F.
WARP.			WEFT—continued.		
	Pence.	*Pence.*		*Pence.*	*Pence.*
60s to 120s	10	11	130s	17	20
130s	10	12	140s	18	20
140s	11	13	150s	19	20
150s	.....	15	160s	20	20
160s	.....	17	170s	21	21
170s	.....	18	180s	.....	22
WEFT.			190s	.....	23
			200s	.....	24
65s to 110s	15	18			
120s	16	20			

Other winding wages might be given, but the foregoing are sufficient to show the general system. There is no uniformity in rates and in some cases quite a difference between one mill and another. As a rule, the country mills pay somewhat less than the mills in Belfast. Payment for winding is almost always per 100 hanks. As

a rule, each girl has 20 skeins, each on its own ryce or swift, to look after, but in some cases slightly more or less. The strength of the yarn is decreased when "treated," so the rate for boiled, bleached, etc., yarn is nearly always more than for the untreated gray or green yarn. Slubbed yarn is paid at a higher rate than unslubbed. In many mills a bonus of 6d. a week is given those who have lost no time. In other cases production is stimulated by paying a bonus of a penny in the shilling on all wages per week earned above a certain minimum.

WEAVING RATES IN VARIOUS MIILLS.

For comparison with the weaving rates shown for mill A the weaver's rates on a few cloths from other mills are given.

WEAVING SCALE OF MILL G FOR PLAIN LINENS IN 100-YARD PIECES.

Construction.	Width.	Rate.	Bonus.	Hours.	Construction.	Width.	Rate.	Bonus.	Hours.
	Inches.	*Pence.*	*Pence.*			*Inches.*	*Pence.*	*Pence.*	
7/7	28	17	2	21	11/12	36	27	3	34
7/8	28	18	2	24	12/13	38	30	3	37
8/9	28	20	2	27	12/14	31	33	3	40
9/10	36	22	2	30	13/15	36	37	3	42
9/11	36	25	3	33	14/15	30	38	4	42
10/11	36	26	3	33					

WEAVING SCALE OF MILL H FOR PLAIN, FINE LINENS 38 INCHES WIDE IN 100-YARD PIECES.

Construction.	Rate.	Bonus for perfect work.	Construction.	Rate.	Bonus for perfect work.
	Pence.	*Pence.*		*Pence.*	*Pence.*
9/10	28	1	13/15	40	3
9/11	30	1	14/15	43	4
10/11	30	2	14/16	46	4
10/12	32	2	15/16	46	5
11/12	32	2	15/17	49	5
11/13	34	2	16/17	51	6
12/13	35	2	16/18	54	6
12/14	37	2	17/18	63	7
13/14	38	3	17/19	65	7

WEAVING SCALES OF MILLS J AND K FOR LAWNS.

LAWN.

Reed.	Shots.	Width.	Rate per 90 yards.	
			Mill J.	Mill K.
		Inches.	*Pence.*	*Pence.*
20oo	20	36¼	90	67
20oo	20	41½	99	76
20oo	21	44	106	80
19oo	20	38	84	65
18oo	19	41½	72	62
16oo	16	43½	55	55
14oo	15	52	60	53
13oo	13	40½	42	39

WEAVING SCALES OF MILLS J AND K FOR LAWNS—Continued.

LAWN WITH TAPED BORDER.

Reed.	Shots.	Width.	Rate per 90 yards.	
			Mill J.	Mill K.
12oo	13	36	49	43
12oo	13	42	54	47
12oo	13	47½	56	49
15oo	16	50	81	73

SHEER LAWN.

14oo	13	37	52	.....
14oo	13	43½	58	.....
14oo	13	43½	66	.....
14oo	16	43½	64	.....
15oo	14	43½	63	.....
16oo	15	37	62	.....
16oo	15	43½	67	.....
17oo	15	43½	84	.....
18oo	16	35	72	.....
18oo	16	43½	90	.....

WEAVING SCALE OF MILL L FOR PLAIN LINENS.

Construction.	96-yard piece, 24½ to 33 inches wide.	90-yard piece, 34 and 35 inches wide.	90-yard piece, 36 inches wide.	90-yard piece, 38 inches wide.	100-yard piece, 36 inches wide.	100-yard piece, 38 inches wide.	106-yard piece, 38 inches wide.
	Pence.	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*	*Pence.*
8/10	22	24	25	25	25	28	.....
9/11	25	27	28	28	28	31	32
10/12	27	29	30	30	30	33	34
11/13	29	32	33	32	33	36	37
12/14	32	33	36	33	36	39	41
13/15	33	38	39	38	39	42	45
14/16	39	43	44	42	44	46	.....
15/17	44	47	48	46	48	51	.....
16/18	.....	51	52	50	52	55	.....
17/19	.....	61	62	60	62	67	.....
18/19	.....	68	63	67	69	74	.....

For perfect work there is paid the following bonus: 3d. a cut extra for 8, 9, 10, 11, 12, and 14 shot work; 4d. for 15 shot; 5d. for 16 shot; 6d. for 17 shot; 7d. for 18 shot; 8d. for 19 shot; 9d. for 20 shot; and 10d. for 21 shot. There is also a bonus of a penny in the shilling for all wages earned from 3s. to 12s. a week.

Mill J is located at a small town and mill K in the country. The scales for these two mills give some idea of the variation that may be encountered in factories working on the same class of goods. In bordered work, in mill J more is paid for broken or fancy borders than for tapes. For instance, 1s. more is paid for 5 tapes than for 1 tape, whereas in mill K there is no difference.

CAUSES OF VARIATIONS IN WAGES.

Other weaving scales might be given, but the foregoing are sufficient to give an idea of the systems and to show that there is no uniformity. Conditions vary so from mill to mill according to the availability of local labor and whether the mill is in the city or the country, the fineness of the yarns used, and the quality of the ma-

terial, the degree of perfection desired in the work (where very perfect work is desired the speed of looms and hence the output is lower), etc., that the weaving scales in themselves without a considerable amount of correlated data are of no great value except to show the system and the general level of piecework rates.

That there is no uniform scale is due partly to the unorganized condition of the labor and partly, the manufacturers say, to the character of the work. Yarns of the same lea may vary widely in strength and weaving power owing to their condition and to the difference in quality of the flax used in their production, and goods with the same yarn leas and the same reed and pick may be woven with different speeds, etc., owing to the use to which they are to be put. Most linen weavers operate two looms each, a few may run three, while on goods that have to be woven absolutely perfect the weaver may be given only one loom. One-loom weavers are usually paid a higher rate than two-loom weavers, but in some cases the weaver is paid the same rate and given a bonus of 3s. or more per loom per week if the work is done correctly.

LABOR ORGANIZATIONS.

There are several labor unions in the Irish linen industry, the ones noted in the Government report on labor unions having the following memberships at the end of 1910:

Unions.	Men.	Women.
Textile Operatives of Ireland	65	2,411
Flax Roughers and Yarn Spinners	1,207	177
Ulster Weavers and Winders	382	245
Portadown Textile Operatives	391	611
Flax Dressers	1,100	.....
Irish Linen Lappers	136	.....
Beetling Enginemen	245	.....
Belfast Power-Loom Yarn Dressers	170	.....
Power Loom Tenters of Ireland	420	.....
Hand Loom Damask Weavers of Lisburn	34	.....
Lurgan Hemmers and Veiners	.....	622
Hand Loom Weavers of Ireland	164	10

Labor-union leaders state that the unorganized condition of the workers is due largely to the fact that most of the operatives are women, and to the further fact that religious and political differences prevent their organizing to work for any common end. Ulster was largely settled by Protestants from Scotland and England, and there have been religious and political differences of centuries between them and the local Irish, who, like the inhabitants of the other three Provinces of Ireland, are mainly Catholics and Home Rulers. Any move, even for better wages and conditions, on the part of one section is usually opposed as a matter of course by other sections. There have been strikes that have secured advances in wages, but these have been almost entirely in isolated mills where the bulk of the workers happened to be of the same church or party.

WORKING HOURS.

In Ireland, as in the rest of the United Kingdom, the legal hours are 55½ per week. There is no legal restrictions as to hours where men only are employed, but as most of the operatives are women

and children, the mills are practically limited to the legal 55½ hours per week. Different periods are worked, but as a rule the Irish mills start at 6.30 a. m. and work to 8.15, when there is a stop till 9 for breakfast; then they work from 9 to 1 p. m., when there is a stop for lunch until 1.45. Work stops at 6 p. m. Saturday morning they stop only 30 minutes for breakfast and the machinery stops at 12 and there is then a half hour for cleaning the machinery.

COST OF TYPICAL IRISH FLAX SPINNING AND WEAVING MILL.

To show concretely the different machines required, together with usual productions and wages in typical mills and factories in the Belfast flax industry, the following complete data were obtained from a prominent Irish textile expert.

SPECIFICATIONS OF CLOTH TO BE MANUFACTURED.

The article to be made is what is known as 38-inch 10/12 linen rough, which is a medium fineness of a cloth extensively manufactured at Belfast. This cloth is known as a 10^{00} because it is made with a reed having 1,000 splits, 2 ends to a split, in the standard width of 40 inches. There are 2,000 ends in the warp. Such cloth to finish 38 inches has the warp spaced 40 inches in the reed, which, with 7½ per cent contraction, gives a 37-inch width from the loom, and in finishing this is beetled out to 38 inches. The picks are given as 12 under a 37-inch glass, which means that there are 12 picks in every thirty-seven two hundredths of an inch of length. The cloth is made with 50s lea warp and 65s lea weft; 100 yards of warp produce 85 yards of cloth (trade yards of 37 inches).

The weight of warp in each cut works out as $\frac{40\times1{,}000\times2\times100}{40\times50\times300}$ or 13.33 pounds. The weight of weft in each cut works out as $\frac{12\times200\times40\times85}{65\times300\times36}$ or 11.62 pounds.

In each 85 yards (37-inch yards) of cloth, therefore, there are 24.95 pounds of yarn. A cut of cloth is 38 inches wide and 85 37-inch yards long, so measures 92.215 square yards. As 24.95 pounds is 399.2 ounces, this makes the cloth weigh 4⅓ ounces to the square yard.

Looms with 42-inch reed space on such cloth are run at 160 picks per minute, and figuring on a 75 per cent production the outturn per loom per 10-hour day is $\frac{160\times60\times10\times37}{12\times200\times37}\times0.75$, or 30 yards.

In estimating the amount of yarn required there is allowed 2½ per cent of warp and 5 per cent of weft to cover waste in winding and weaving. For each cut, therefore, there is needed 13.33 divided by 0.975, or 13.67 pounds of warp, and 11.62 divided by 0.95, or 12.23 pounds of weft, a total of 25.90 pounds of yarn per cut.

COST OF SPINNING MILL.

The average flax-spinning mill has about 20,000 spindles, so that we shall figure on a spinning mill of this size making 50s lea warp and 65s lea weft and then figure on a weave shed with sufficient looms to take up the product of the spinning mill.

The first cost complete of an Irish flax-spinning mill of 20,208 spindles making 50s lea warp and 65s lea weft will be as follows:

Items.	English currency.	American currency.
MACHINERY.		
11 duplex hackling machines of latest type fitted with automatic screwing mechanism and with automatic spreader and sliverer attached, at £1,110 each	£12,210	$59,419.96
93 heads, first drawing, doubling 12 into 1, at £62 a head	5,766	28,060.24
93 heads, second drawing, doubling 12 into 1, at £62 a head	5,766	28,060.24
62 heads, third drawing, doubling 16 into 1, at £62 a head	3,844	18,706.83
62 heads, fourth drawing, doubling 8 into 1, at £62 a head	3,844	18,706.83
31 roving frames, with 8 by 4 inch bobbins, 80 spindles each; total of 2,480 spindles, at 125s. per spindle	15,500	75,430.75
42 warp-spinning frames, of 2⅛-inch pitch, 224 spindles each; total of 9,408 spindles, at 15s. 6d. per spindle	7,291	35,481.65
45 weft-spinning frames, of 2-inch pitch, 240 spindles each; total of 10,800 spindles, at 14s. 6d. per spindle	7,830	38,104.70
100 double reels, 40 bobbins to the reel, at £25 each	2,500	12,166.25
1 long Marr's hank-drying machine	730	3,552.54
7 yarn-bundling presses, at £130 each	210	1,021.96
Total	65,491	318,711.95
MACHINE ACCESSORIES AND STORES.		
Hackles and spares	85	413.65
Spare gills and pins	50	243.32
Sliver cans, 14-inch, for autospreaders, 12-inch for first drawing, 10-inch for second drawing, 9-inch for third drawing, 8-inch for fourth drawing, all 38 inches high, total of 11,200 cans, at 3s. each	1,680	8,175.72
Trucks, rove carts, etc	20	97.33
Flyer eye wire and apparatus	20	97.33
2 preparing-room slide lathes, at £20 each	40	194.66
6 fluting machines, at £90 each	540	2,627.91
Weighing machines	70	340.66
Rove reel, etc	4	19.46
280 gross 8 by 4 inch rove bobbins, at 28s. per gross	392	1,907.67
700 gross spinning bobbins, 2 by 1 inch and 2⅜ by 1¼ inch, at 3s. per gross	105	510.98
280 gross spinning-frame pressing rollers, 2 by ⅝ inch and 2¼ by ¾ inch, of boxwood, at 10s. per gross	140	681.31
500 bobbin cages, at 3s. each	75	364.99
Yarn tester	8	38.93
Cotton banding	30	146.00
Total	3,259	15,859.92
BUILDING AND EQUIPMENT, STEAM PLANT, ETC.		
Three Lancashire shell boilers, 30 feet by 7 feet 6 inches, with piping and fittings, at £600	1,800	8,759.70
One 800-horsepower cross-compound condensing engine	3,200	15,572.80
One 298-tube economizer with valves, dampers, etc	350	1,703.27
Stokers, feed pumps, and other engine and boiler equipment	250	1,216.63
Engine and boiler seatings	2,000	9,733.00
Chimney	500	2,433.25
Shafting, pulleys, hangers, couplings, etc	1,000	4,866.50
Ropes and belting	650	3,163.23
Humidification and dust-removal plant	700	3,406.55
Electric-light equipment complete	400	1,946.60
Buildings and miscellaneous	62,000	301,723.00
Total	72,850	354,524.53
Grand total	141,600	689,096.40

The total first cost of the flax-spinning mill, in Ireland, complete with buildings, equipment, and machinery, ready to operate, would therefore be £7 2d., or $34.10, per spindle. No allowance is made for real estate.

The floor space required for the mill will be about 7,500 square yards, and the building will be 234 by 53 feet square and 5 stories high. The machine hackling and the preparing rooms take up the first two floors, the next two are occupied by the spinning, and the top floor by the reeling and yarn room. The yarn is wet-spun and is dried in a loft over the boiler. Roughing is carried on in a sepa-

rate one-story building, which, with the adjacent raw flax storeroom, requires some 600 square yards.

SPINNING MILL PRODUCTION, SPEEDS, ETC.

The 50s lea warp is made from Irish flax and the 65s lea weft from Baltic flax. There will be required to run the mill 8,043 pounds of scutched Irish and 7,126 pounds of scutched Baltic flax each day of 10 hours. The total raw material required is therefore 15,169 pounds each 10 hours.

In the mill the first process is that of hand hackling, or roughing. Some of the Baltic flax can be pieced out without making tow, but all of the Irish flax, as well as a large portion of the Baltic, is roughed in the regular way. In most of the Irish mills the tow made in the roughing and in machine hackling is reworked into lower-grade yarn, but as we are figuring on a mill making one standard article only, we shall consider the tow as being sold. From the 8,043 pounds of scutched Irish there will be obtained 7,325 pounds of roughed Irish and 610 pounds of tow, the waste being 108 pounds. From the 7,126 pounds of scutched Baltic there will be obtained 6,681 pounds of roughed Baltic and 318 pounds of tow, the waste being 127 pounds. The total roughed flax available in 10 hours' working will therefore be 14,006 pounds.

The duplex hackling machines considered in this mill are of the very latest type, and attached to each is an automatic spreader and sliverer, so that the machine takes in pieces of roughed flax and turns out continuous sliver without any intermediate handling, thus saving the extra labor involved in the use of separate spreading machines. Each hackling machine has 12 tools, or hackling machines, for the top end and 12 for the root end. The pins on the first tool are spaced one-fourth inch apart, and vary from this up to 30 pins to the inch on the twelfth, or finishing, tool; the size of wire used varies from No. 10 to No. 25 B. W. G. The hackling sheets are run at 16 revolutions per minute, and 10 lifts of the head may be made per minute. From the 7,325 pounds of roughed Irish there will be obtained 4,021 pounds of machined Irish, the tow amounting to 3,088 pounds and the waste to 216 pounds. From the 6,681 pounds of roughed Baltic there will be obtained 3,563 pounds of machined Baltic and 2,862 pounds of tow, the waste amounting to 256 pounds. The total outturn of machined flax from 10 hours' working will, therefore, be 7,584 pounds.

In the preparing room each system consists of four processes of drawing and one of roving. Each three heads of first and second drawing are followed by two heads of third and fourth drawing, and each two heads of the fourth, or finisher, drawing supply sliver for one roving frame of 80 spindles. The screw-gill or spiral system of driving the hackles is used throughout.

The roving frames have 80 spindles each, using 8 by 4 inch bobbins, and at a spindle speed of 600 revolutions per minute will turn off per spindle per 10 hours 3 pounds of rove measuring 100 yards to the ounce. The total production from the 2,480 spindles is 7,440 pounds of rove each 10 hours.

Weft-spinning frames of the flyer type are the only kind used for such leas of flax. There are 42 frames of 224 spindles each, or a

total of 9,408 spindles, on 50s lea warp, and 45 frames of 240 spindles each, or a total of 10,800 spindles, on 65s lea weft; the total warp and weft spindles therefore number 20,208.

On the warp frames the reach, or distance from center to center of the retaining and drawing rollers, is set at $2\frac{1}{4}$ inches; the pitch, or distance from center to center of the spindles, is $2\frac{1}{8}$ inches; and the small double-headed bobbins used are $2\frac{1}{8}$ by $1\frac{1}{4}$ inches. On the weft frames the reach is set at 2 inches, the pitch is also 2 inches, and the bobbins are 2 by 1 inch.

Using rove weighing 100 yards per ounce, the draft on the warp frames making 50s lea warp figures out as $\frac{300\times50}{100\times16}$, or 9.38; similarly, the draft on the weft frames making 65s lea weft figures out as $\frac{300\times65}{100\times16}$, or 12.19.

The speed of the spindles is 5,000 revolutions per minute, and we shall allow 14 turns twist per inch for both warp and weft and figure on 90 per cent production in both cases. The total warp production per day of 10 hours figures out as $9{,}408\times\frac{5{,}000\times60\times10}{14\times36\times50\times300}\times0.90=$ 3,360 pounds. The total weft production per day of 10 hours figures out as $10{,}800\times\frac{5{,}000\times60\times10}{14\times36\times65\times300}\times0.90=2{,}967$ pounds. This gives a total yarn production per 10 hours from the spinning room of 6,327 pounds of yarn. Taking the productive working week as 54 hours, there will be produced 18,144 pounds of warp and 16,022 pounds of weft, or a total of 34,166 pounds of yarn.

Each reeler runs one side of 20 bobbins and is paid by the 100 hanks reeled. The 18,144 pounds of 50s lea warp is equivalent to 75,600 hanks of 3,600 yards, or 4,536 bundles of 60,000 yards. The 16,022 pounds of 65s lea weft is equivalent to 86,780 hanks of 3,600 yards, or 5,207 bundles of 60,000 yards.

COST OF OPERATING SPINNING MILL.

The following table gives the wages paid for operating the mill one week. Of the operatives listed, 119 are men and boys, while 591 are women and girls.

Operatives.	Weekly wages.	
	English currency.	American currency.
ROUGHING ROOM.		
	£ s. d.	
1 roughing master, at 30s. per week	1 10 0	$7.30
31 roughers on Irish flax turning out 353 hundredweight a week, at 2s. 3d. per hundredweight	39 14 3	193.26
12 roughers on Baltic flax turning out 144 hundredweight a week, at 2s. per hundredweight	14 8 0	70.08
10 piecers-out on Baltic flax turning out 178 hundredweight a week, at 20s. per week	10 0 0	48.66
MACHINE-HACKLING ROOM.		
1 machine master, at 30s. per week	1 10 0	7.30
11 machine boys, at 10s. 6d. per week	5 15 6	28.10
5 tipplers-up and bunch openers, at 10s. 6d. per week	2 12 6	12.77
3 tow boys, at 8s. per week	1 4 0	5.84
1 oiler, at 15s. per week	15 0	3.65

Operatives.	Weekly wages.	
	English currency.	American currency.
PREPARING ROOM.	£ s. d.	
1 head preparing master, at £3 per week	3 0 0	$14.60
2 preparing masters, at 30s. per week	3 0 0	14.60
3 set boys, at 15s. per week	2 5 0	10.95
62 draw-frame minders, at 10s. 6d. per week	32 11 0	158.41
31 back minders, at 10s. 6d. per week	16 5 6	79.20
31 roving-frame minders, 80 spindles each, at 12s. 6d. per week	19 7 6	94.28
2 doffing mistresses, at 15s. per week	1 10 0	7.30
16 doffers, at 8s. per week	6 8 0	31.15
4 rove carriers, at 20s. per week	4 0 0	19.46
2 roller boys, at 15s. per week	1 10 0	7.30
1 cleaning master, at 20s. per week	1 0 0	4.87
10 cleaners, at 9s. per week	4 10 0	21.90
SPINNING ROOM.		
1 head spinning master, at £3 per week	3 0 0	14.60
2 spinning masters, at 30s. per week	3 0 0	14.60
56 warp spinners, 1½ sides or 168 spindles each, at 12s. per week	33 12 0	163.51
60 weft spinners, 1½ sides or 180 spindles each, at 12s. per week	36 0 0	175.19
45 piecers, at 11s. per week	24 15 0	120.45
30 layers, at 10s. per week	15 0 0	73.00
12 cagers, at 7s. per week	4 4 0	20.44
6 doffing mistresses, at 16s. per week	4 16 0	23.36
60 doffers, at 9s. per week	27 0 0	131.40
2 oilers, at 15s. per week	1 10 0	7.30
2 sweepers, at 15s. per week	1 10 0	7.30
REELING ROOM.		
1 reeling master, at 30s. per week	1 10 0	7.30
70 warp reelers, reeling 75,600 hanks, at 12d. per 100 hanks	37 16 0	183.95
100 weft reelers, reeling 86,780 hanks, at 17d. per 100 hanks	61 9 4	299.13
6 hank driers, at 25s. per week	7 10 0	36.50
6 hank bundlers, at 25s. per week	7 10 0	36.50
GENERAL LABOR.		
1 engineer, at 30s. per week	1 10 0	7.30
1 oiler and greaser, at 20s. per week	1 0 0	4.87
2 boiler-room men, at 20s. per week	2 0 0	9.73
1 machinist, at 30s. per week	1 10 0	7.30
2 assistant machinists, at 20s. per week	2 0 0	9.73
1 hoist man, at 15s. per week	15 0	3.65
3 yard and warehouse men, at 20s. per week	3 0 0	14.60
Total	454 13 7	2,212.69

COST OF WEAVING FACTORY.

The cloth to be made from the 50s lea warp and 65s lea weft produced in the flax-spinning mill described is 38-inch, 10/12 linen roughs. With 75 per cent production it has been shown that a weaver would get off 30 yards of cloth per loom in 10 hours and therefore in 54 hours actual working time 162 yards per week per loom. The production of 680 looms would be 110,160 yards per week, or 1,296 cuts of 85 yards each (figuring on trade yards of 37 inches). Each cut weighs 24.95 pounds, so the weekly output from the factory would be 32,355 pounds of cloth. Allowing for waste, as previously shown, there is required a total of 25.90 pounds of yarn per cut, or 33,566 pounds of yarn total, from the spinning mill, and of this, 17,716 pounds would be warp and 15,850 pounds weft.

The 17,716 pounds of 50s lea warp contains 73,788 hanks of 3,600 yards, or 4,429 bundles of 60,000 yards; the 15,850 pounds of 65s lea weft contains 85,854 hanks, or 5,151 bundles.

The weft on arrival at the factory is wound from the skein onto pirns about 6 by 1¼ inches in size and sent direct to the looms, each weft winder tending about 16 pirns. The warp on arrival at the factory is wound from the skein onto spools 5 by 4 inches in size and these are placed in the creel of beam warpers and run onto beams. In this case 500 ends will be run onto each beam and each such beam of 50s lea warp will hold about 8,000 yards. Four of these beams at a time are placed in the dressing machine creels, two at each end, and are sized, dried, and wound up together on the weaver's beam in the center, each weaver's beam therefore holding 2,000 ends and having a warp length of about 400 yards. If 1,296 cuts of cloth are produced per week and each beam holds four cuts this necessitates 324 beams a week from the dressing machines.

Each weaver tends two looms and in addition to weaving has to fetch her own weft from the storeroom and has to inspect and repair any minor defects in the cloth after weaving, clip off all loose threads, and carry same to the clothroom herself. Sweeping and oiling are usually performed by cheaper help.

The total first cost of a typical Irish linen factory complete with buildings, equipment, and machinery, ready to operate would be £48 18s. 5d., or $238.06, per loom, as shown by the following statement. No allowance, it will be noted, is made for real estate.

Items.	English currency.	American currency.
MACHINERY.		
7 warp-winding machines of 100 drums each, total of 700 drums, at 18s. per drum	£630	$3,065.90
16 weft-winding machines of 100 spindles each, total of 1,600 spindles, at 22s. per spindle	1,760	8,565.04
6 beam warpers and banks, at £46 each	276	1,343.15
2 dressing machines, at £250 each	500	2,433.25
14 drawing-in frames, at £4 each	56	272.52
680 overpick looms, 42-inch reed space, equipped ready for operation, at £13 each	8,840	43,019.86
2 cropping machines, at £80 each	160	778.64
4 treating and washing jigs, at £30 each	120	583.98
2 sets of drying cans, at £450 each	900	4,379.85
2 patent beetles, at £560 each	1,120	5,450.48
2 folding machines, at £25 each	50	243.32
1 hydraulic cloth press, at £40 each	40	194.66
MACHINE ACCESSORIES AND STORES.		
1,360 gross pirns, 6 by 1¼ inches, at 2s. 6d. per gross	170	827.31
60 gross spools, 5 by 4 inches, at 22s. per gross	66	321.19
680 spare loom beams at 25s. per beam	850	4,136.52
340 pounds buffalo hide pickers, at 19d. per pound	27	131.40
BUILDING AND EQUIPMENT, STEAM PLANT, ETC.		
Two Lancashire shell boilers, 30 feet by 7 feet 6 inches, with piping and fittings, at £600	1,200	5,839.80
One 400-horsepower cross-compound condensing engine	1,600	7,786.40
Various engine and boiler accessories	400	1,946.60
Engine and boiler seatings	1,200	5,839.80
Shafting, pulleys, hangers, couplings, etc	800	3,893.20
Ropes and belting	500	2,433.20
Buildings and miscellaneous	12,000	58,398.00
Total	33,265	161,884.12

COST OF OPERATING WEAVING FACTORY.

The following statement shows the wages of operatives in the weaving mill described:

Operatives.	Weekly wages. English currency.	Weekly wages. American currency.
YARN PREPARATION ROOM.	£. s. d.	
1 foreman yarn preparation, at 30s. per week	1 10 0	$7.30
70 warp winders turning off 73,788 hanks a week, at 15d. per 100 hanks	46 2 4	224.43
100 weft winders turning off 85,854 hanks a week, at 19d. per 100 hanks	67 11 0	328.73
9 warpers and creelers turning off 530,000 yards, at 3d. per 1,000 yards of 500 ends	6 12 6	32.24
1 head dresser, at 35s. per week	1 15 0	8.52
2 dressers, at 25s. per week	2 10 0	12.16
14 drawing-in hands turning out 324 beams a week, at 8d. per 1,000 splits (1,000 splits in reed used)	10 16 0	52.56
2 sweepers and oilers, at 15s. per week	1 10 0	7.30
WEAVING ROOM.		
340 weavers, tending 2 looms each, turning off a total of 1,296 cuts a week, at 36d. per cut	194 8 0	946.05
12 tenters, at 20s. 6d. per week, plus a bonus of a shilling in the pound of the wages made by the weavers	22 0 5	107.16
1 oiler, at 15s. per week	15 0	3.65
2 sweepers, at 15s. per week	1 10 0	7.30
FINISHING ROOM.		
1 head finisher, at 35s. per week	1 15 0	8.52
2 croppers, at 17s. 6d. per week	1 15 0	8.52
4 men at treating and washing jigs, at 17s. 6d. per week	3 10 0	17.03
2 men at drying cans, at 17s. 6d. per week	1 15 0	8.52
2 beetlers, at 20s. per week	2 0 0	9.73
2 folders, at 15s. per week	1 10 0	7.30
2 men at baling press, at 20s. per week	2 0 0	9.73
GENERAL LABOR.		
1 engineer, at 30s. per week	1 10 0	7.30
2 boiler-room men, at 20s. per week	2 0 0	9.73
1 machinist, at 30s. per week	1 10 0	7.30
2 assistant machinists, at 20s. per week	2 0 0	9.73
3 yard and warehouse men, at 20s. per week	3 0 0	14.60
Total	381 5 3	1,855.41

LINEN INDUSTRY IN SCOTLAND.

In the flax-manufacturing trade of the United Kingdom Scotland has always been noted for its coarse and heavy goods and Ireland for its finer and lighter goods. In value the output of the Scottish industry is much less than that of the Irish industry, but in weight it is almost as large.

The linen industry of Scotland is of considerable antiquity, and by the close of the sixteenth century linen goods formed the principal article of export to foreign countries. Flax was spun by distaff and spindle, and the process of manufacture was exceedingly slow and tedious, though somewhat accelerated by the introduction in 1533 of the spinning wheel. At Dundee, its main center, the industry suffered so much from wars and other vicissitudes that Parliament in 1707 granted a bounty on cloth exports. The bounty was liberal in terms and differed according to the destination of the cloth, being 5d. to 6d. per yard for cloth shipped to British possessions and ranging as high as 1s. 6d. per yard on exports to foreign ports. The bounty was continued until 1832, when it was withdrawn as no longer needed.

Flax spinning was entirely a hand industry up to the latter part of the eighteenth century, when the steam engine, the spinning frame, and many other mechanical inventions were introduced. Dundee shares with Leeds the distinction of being the first to make a commercial success of flax spinning by machinery. It was not until about 1820, however, that power spinning began to be used extensively, and it was not until 1836 that power weaving was inaugurated. The Scottish flax industry was passed by the Scottish jute industry about 1855, but, owing largely to the American Civil War demand, continued to expand until 1871, since which time it has declined.

In the British linen trade it has been a case of the survival of the fittest, and certain advantages possessed by Ireland have led to the concentration of the industry in that country at the cost of both Scotland and England. According to official figures for the year 1850 England led with 365,568 spindles on flax, and was followed by Ireland with 326,008 and Scotland with 303,125. England attained its maximum with 441,759 spindles in 1856, but now has less than 50,000. Scotland attained its maximum in 1871 with 317,085, but by 1905 had declined to 160,085, and to-day probably has less than 150,000 spindles. The latest Government figures are for 1905, and, according to these, Ireland declined from 906,946 in 1875 to 812,952 spindles in 1905; but, according to the figures of the Irish Flax Supply Association, there has since been a great revival of business, and the maximum of 951,362 spindles was attained in 1912.

GOVERNMENT STATISTICS OF SPINDLES AND LOOMS.

The following statistics, collected and issued by the Factory Department of the Home Office, show the status of the linen industry in the three sections of the United Kingdom for a number of years:

SPINNING SPINDLES.

Years.	Ireland.	Scotland.	England and Wales.	United Kingdom.
1850	326,008	303,125	365,568	994,701
1856	567,980	278,304	441,759	1,288,043
1861	592,981	279,385	344,308	1,216,674
1868	894,273	256,228	437,623	1,588,124
1871	886,482	317,085	269,768	1,453,335
1875	906,946	275,119	291,735	1,473,800
1879	808,695	265,263	190,808	1,264,766
1885	817,014	220,644	117,559	1,155,217
1890	840,448	187,755	106,610	1,134,813
1905	812,936	160,085	49,941	1,022,978

DOUBLING SPINDLES.

1875	18,616	15,432	47,287	81,335
1879	18,048	18,495	28,439	64,982
1885	19,262	22,629	23,269	65,160
1890	29,024	20,599	11,898	61,521
1905	22,859	22,497	7,521	52,877

LOOMS.

1850	58	2,529	1,083	3,670
1856	1,871	5,011	1,987	8,869
1868	12,969	12,985	5,086	31,040
1871	14,834	17,419	3,048	35,301
1875	17,827	18,529	5,624	41,980
1879	19,611	16,756	4,081	40,448
1885	21,954	21,626	4,061	47,641
1890	25,555	16,687	4,472	46,714
1905	32,831	17,185	4,424	54,440

DECLINE IN SCOTTISH SPINDLES.

In 1850, though last in the number of spindles, Scotland led both England and Ireland in the number of looms, having 2,529, as against 1,083 in England and only 58 in Ireland. Since 1905 the number of looms in Scotland has not increased, while Ireland by 1915 had twice as many looms as Scotland. The Scottish weaving industry, however, has not declined to the same extent as the spinning industry. The latter meets with severer competition from abroad than weaving, and as a result Scotland has had to import a continually increasing proportion of its yarn requirements from the Continent. Owing partly to its relatively larger import of foreign yarns and partly to the coarser grade of goods manufactured, Scotland has fewer spindles to the loom than England, and many less than Ireland. In 1905, the latest year for which complete statistics are available, Ireland had 24.8 spindles per loom, England 11.3, and Scotland only 9.3.

Scotland has always made the coarser and heavier grades of linen goods, and it has therefore felt more severely the growing competition of the Continent than has Ireland, which works more on the finer end of the industry. Ireland is noted for its production of cambrics,

lawns, and other fine and medium plain-woven linens, in which wet-spun yarns are used, while Scotland is noted for the manufacture of the heavier grades of domestics, sailcloth, canvas, and duck from dry-spun yarns. The small amount of wet-spun yarns used in Scotland is imported, either from the Continent or from Ireland, and in the manufacture of such goods as damasks, for which Dunfermline has been famous for a couple of centuries, there is increasing competition from Belfast and abroad.

MANUFACTURE OF SAILCLOTH.

One thing severely affecting a very important branch of the Scottish industry has been the gradual displacement of sailing vessels by steamers and the consequent diminution in the consumption of sail canvas. In 1852 there were on Lloyd's register 10,241 sailing vessels and 156 steamers, while in 1902, fifty years later, there were 2,689 sailing vessels and 8,352 steamers. Though the demand is smaller than formerly, the sailing ships that remain, the large fleets of yachts, and the requirements of tentmakers, etc., still account for a considerable consumption of canvas. The bulk of the ships' canvas required by the Royal Navy has always been obtained from Scotland, and in addition there have been large purchases for foreign navies, including the American. The extent of the Royal Navy requirements is shown by the Admiralty orders for sailcloth in a recent year as follows: 3,500 yards red, 51,800 yards gray Merchant Navy, 110,000 yards gray Royal Navy, 444,000 yards white Merchant Navy, 1,196,000 yards white Royal Navy.

In addition to the orders for Royal Navy canvas for sails and Merchant Navy canvas for awnings and duck for seamen's clothing, there are large orders annually from various departments of the Government for other flax goods such as tent duck (the 27-inch, 10¼-ounce being ordered by the hundreds of thousands of yards), canvas for clothing (especialy the 36-inch, 11¼-ounce), black duck for kitbags (mainly the 34-inch, 17-ounce), drab duck for gaiters (mainly the 24-inch, 12-ounce), linen dowlas of various makes, flax sheeting, osnaburgs (for bed coverings), etc. The Royal Navy contracts are largely taken by Baxter Bros. & Co. (Ltd.), who employ some 4,000 operatives, but a large number of the Scottish spindles and looms run on some of the various goods required by Government departments. The Government orders are of such value to the Scottish industry, especially the Dundee section, that they are usually placed at home even though lower bids are obtained from abroad. For instance, in 1910 the Secretary of State for the Home Department stated in Parliament that he had placed orders for 704,500 yards of Scottish woven canvas for mail bags though the home price at £31,042 2s. 11d. was £985 7s. 6d. ($4,795.32) above foreign offers. A considerable proportion of this canvas and other Government orders, though woven in Scotland, was made with imported yarn.

SCOTTISH LINEN MILLS.

At one time there was an extensive cotton industry around Belfast in Ireland, but this was displaced by the linen industry, and only one important cotton mill is left. In Scotland the reverse has been the case, for though at one time there was an important linen

industry in the southwest around Glasgow, in Lanarkshire, and Paisley, in Renfrewshire, the invasion of cotton mills drove the more difficult industry with its lower wage scale to the eastward. Not only this, but the subsequent rise of the jute industry at Dundee came near wiping out the linen industry at its most important Scottish center.

In Scotland the linen industry is now almost entirely confined to the eastern counties of Forfarshire and Fifeshire. The chief towns are Dundee and Dunfermline, the former for the coarser fabrics, such as sailcloth, sacking, and sheeting, and the latter for table linen.

PRINCIPAL LINEN MANUFACTURERS.

According to the best data obtainable the following are the largest firms in the Scottish flax industry, those having over 10,000 spindles or 500 looms:

Firms.	Location.	Spindles.	Looms.
Baxter Bros. & Co. (Ltd.)	Dundee	20,000	1,200
Andrew Lowson (Ltd.)	Arbroath	13,000	250
Don Bros., Buist & Co. (Ltd.)	Dundee and Forfar.	10,000	1,000
Erskine Beveridge & Co. (Ltd.)	Dunfermline		1,650
Hay & Roberston	do		1,270
John Shields & Co. (Ltd.)	Perth		900
Inglis & Co	Dunfermline		700
Andrew Reid & Co	do		700
James Mathewson & Son (Ltd.)	do		660
R. E. Walker, Reid & Co. (Ltd.)	do		630
James & Thomas Alexander (Ltd.)	do		600
Lamb & Scott (Ltd.)	Brechin		572
D. & R. Duke	do		560
Robert Wemyss & Co	Kirkcaldy		500
Craiks (Ltd.)	Forfar		500
J. & G. Paton (Ltd.)	Montrose	21,000	

The firms of Baxter Bros. & Co. (Ltd.) and Don Bros., Buist & Co. (Ltd.)—the latter spins at Dundee and weaves at Forfar—work on jute as well as flax. These two, with the smaller firm of South Mills (Ltd.), are now the only surviving flax-spinning mills in Dundee. Craiks (Ltd.), at Forfar, also work partly on jute, while some of the Dunfermline concerns make cotton as well as linen tablecloths, etc.

CHIEF CENTERS OF MANUFACTURE.

Dunfermline, with its eight firms operating 6,540 looms in and around the town, is the largest linen-weaving center of Scotland, but it has no spindles and works largely on imported yarns. Many of these looms are Jacquards, making damask table linen, which has been the staple manufacture of the town since before the invention of power machinery. Kirkcaldy has some 11,000 spindles and 2,700 looms on linen goods, mainly ticks, checks, ducks, towels, etc. There are some 5,420 spindles and 1,500 looms at Forfar, 1,332 looms at Brechin, and 1,035 looms at Perth. Smaller weaving centers are Dysart, Freuchie, Cupar, and Arbroath. The largest flax-spinning firm is at Montrose, other spinning centers besides Dundee being Arbroath, Kirkcaldy, Bervie, Blairgowrie, and Brechin. At no Scottish center does there seem to be any increase of the flax industry, and where it is not declining it is stationary.

RAW MATERIALS.

At one time Scotland raised the bulk of its flax requirements; but as the eastern ports of Scotland are directly across the North Sea from the ports of the Baltic, Scotland was the first to feel the competition of the cheaper labor of the Continent. With the great increase of flax growing in Russia the production of flax in Scotland became less and less remunerative and declined, until to-day there is not an acre left under this crop. Efforts have been made to revive flax growing. In the Jubilee year of 1887, for instance, manufacturers imported and distributed large quantities of linseed free to the farmers and offered liberal inducements to stimulate a home supply. After a short trial the Scottish farmers found themselves unable to compete with the cheaper labor and more favorable climate of Russia, and there is no prospect that they can be induced to try again.

IMPORTS OF FLAX.

At Dundee the first recorded import of flax was 2,348 tons in 1791. In 1821 the import was 5,724 tons, and it gradually increased to a maximum of 50,935 tons in 1891, but with the subsequent great decline in Scottish spinning the amount of flax required fell off correspondingly.

The imports of flax and tow into the eastern ports of Scotland and the total imports into the United Kingdom in recent years are shown in the following table:

Ports.	1900	1905	1910	1911	1912
	Tons.	*Tons.*	*Tons.*	*Tons.*	*Tons.*
Dundee	12,734	18,103	16,864	15,900	24,058
Leith	12,667	8,791	7,991	8,216	8,149
Montrose	4,368	7,413	7,195	7,710	6,593
Aberdeen	2,189	2,890	3,629	3,247	4,275
Arbroath	2,580	2,177	1,914	378	1,644
Fife ports	873	4,230	3,311	3,168	3,050
Total	35,411	43,604	40,904	38,619	47,769
Total, United Kingdom	71,586	90,098	88,442	80,029	105,930

Scottish flax mills, though having less than a fifth of the spindles of the United Kingdom, account for approximately half the total consumption of flax, which is due, as shown elsewhere, to the coarser counts on which they run.

There is a small reexport of flax from the eastern ports, chiefly to the United States, but this is about balanced by the receipts, in addition to the direct imports from foreign countries, by rail and coasting vessels. The reexports, in fact, are a negligible proportion of the total, rarely amounting to more than 1,000 tons. Some flax is imported at Glasgow, but only for reexport, and it does not enter into the Scottish consumption.

Ireland imports fine flax from Belgium and coarse flax from Russia. Scotland spins no fine yarn, so the raw material imported is almost exclusively coarse flax from Russia, coming mainly from the Russian ports of Riga (about half of the total), Windau, Reval, and Pernau. The fleet engaged in this flax-carrying trade across the

North Sea comprises small steamers of about 1,000 tons each, and most of them are Leith-owned vessels. The 24,058 tons of flax imported into Dundee in 1912 were brought in 62 vessels, with a total gross tonnage of 59,521, counting each arrival separately.

IMPORTS OF YARN.

With the rapid decline in Scottish spinning and the slower decline in Scottish weaving an increasing proportion of the yarn has been obtained from abroad. Most of this yarn comes from Belgium and France, with smaller amounts from Germany and Russia. For Scotland, practically the entire yarn import enters at the port of Leith, imports there amounting in 1900 to 12,202,041 pounds, in 1905 to 8,980,011, in 1910 to 11,260,918, and in 1911 to 11,851,757 pounds. Owing to the coarse class of goods manufactured in Scotland, the Scottish imports of yarn, as was shown to be the case with raw flax imports, amount to almost half of the total for the United Kingdom, though the Scottish looms number less than half of the total looms.

PROCESSES OF MANUFACTURE.

The processes in the dry-spinning flax mills of Scotland are usually as follows:

Hackling rooms.—Roughing (optional); machine hackling.

Preparing room.—Spreading; drawing (2 or 3 processes); roving frame.

Spinning room.—Dry spinning.

Yarn department.—Reeling; bundling and baling.

As Scotland requires chiefly coarse yarns, and the fine yarns necessary are obtainable from either the Continent or Ireland, dry spinning is the rule. Dry-spun flax yarns range from 20 pounds per spyndle (having a weight of 20 pounds per spyndle of 14,400 yards and equivalent to 2 lea linen or No. 0.86 cotton yarn) up to as fine as 2 pounds per spyndle, equal to 24 lea linen or No. 8.57 cotton yarn. A trifle is spun to up 1½ pounds per spyndle, equal to 32 lea linen or No. 11.43 cotton yarn, but 2-pound yarn is usually taken as the limit of the dry-spinning frame. The standard size on which prices are usually based is that of 3 pounds per spyndle, equivalent to 16 lea linen or No. 5.71 cotton yarn.

HACKLING AND PREPARING.

In the Scottish spinning trade there is no sorting process as in the Irish fine-yarn mills, and even roughing is rather rare. Very coarse flaxes are not worth the expense of roughing, while the better marks of coarse flaxes, such as Archangel and Rjeff, are generally even and tidy enough not to show the omission of roughing when woven into heavy goods. Stacking, which is a simpler and cheaper system of hand dressing, is sometimes used instead; it consists mainly of a mere draw over the pin points of the hackle to level the fiber.

The hackling machines are similar to those described for Ireland, though fewer mills have adopted the duplex machine. The extra labor required on the old-style types of single machines is made up by using larger pieces and by running the machines considerably faster. The exceptionally high rate of speed in the Scottish mills causes great wear and tear on the machines, and it is claimed by some authorities to be detrimental to the yield of dressed line.

The spreading machine is similar in type to that described for Ireland, though with the necessary modifications as to coarser hackles, etc., to suit the coarser flax used; they are also operated at excessive speeds. The same is true of the drawing frames and of the roving machine, except that more than three processes of drawing are never used.

DRY-SPINNING SYSTEM.

The dry-spinning frame, aside from the absence of the water troughs, differs in many ways from the wet-spinning frame. The drawing and retaining rollers are of steel. The top one is fluted, but the bottom, or drawing, roller is merely scored sufficiently to give it gripping power, as the dry fibers with an ordinary weight have little tendency to slip. Pressing rollers are placed behind the long rollers and are pressed against them by means of a lever and weight.

In wet spinning the fibers, after coming through the water trough, are stuck together, and how far they are to be drawn depends on the strength and size of the yarn to be made; hence, the reach, or distance between the pairs of feed and drawing rollers, is changed to suit the different conditions by raising or lowering the top roller the required distance. In dry spinning the ultimate fibers are not disturbed and the long fibers are drawn past each other, so that after being once adjusted to the length of the fiber being spun the reach is not altered. The reach of dry-spinning frames is, of course, much longer and varies from 7½ inches for tow up to the 18 inches customary for flax.

In dry spinning the flyer, though doing the same work and placed on the spindle in the same manner as for wet spinning, differs in construction and in the way it transfers the yarn from the roller to the bobbin, etc. The brass eye used in wet spinning is discarded, the leg of the flyer is slightly flattened into a fish-tailed shape, and an eye is cut out of the center for the passage of the yarn. In dry spinning the spindle is also placed directly under the drawing-roller delivery instead of slightly forward, as for wet spinning, hence there is less strain on the material. This is one reason why poor yarns in heavy counts can be spun more easily dry than wet from the same material and with less twist. Some dry-spun yarns are made on ring spinning frames.

Dry-spun yarns, of course, need no drying, and the bobbins, which are much larger than those used for fine wet-spun yarns, are carried direct to the reel room, where the yarn is reeled into 90-inch hanks and then bundled. A considerable proportion of the dry-spun yarn is made from tow.

The operations of the factory—weft and warp winding, warping, dressing, drawing-in, and weaving—differ in no essential particulars from those described for Irish weave sheds.

NUMBERING, ETC., OF DRY-SPUN YARNS.

Irish wet-spun yarns are numbered on the lea system, by which the number, or count, of the yarn means the number of 300-yard leas that weigh 1 pound. Dry-spun flax yarns, on the other hand, are numbered the same as jute yarns, and in this case the basis is not the pound, but an arbitrary length of 48 cuts, or leas, of 300 yards each, which make up a spyndle of 14,400 yards, the weight

in pounds of a spyndle being the count of the yarn. For instance, 3-pound yarn means that a spyndle of 14,400 yards weighs 3 pounds; 4-pound yarn means that a spyndle weighs 4 pounds, etc. As a spyndle is 48 leas, dividing 48 by the pounds per spyndle gives the equivalent in leas; or, dividing 48 by the lea count gives the count in pounds per spyndle.

As the spyndle basis is used for both dry-spun flax and jute yarns, and as it is conducive to a clearer understanding of yarn quotations, etc., to know the equivalent in lea or cotton yarns, the following table is given showing the equivalents of spyndle and lea yarns in terms of each other and of cotton counts:

Scottish dry-spun flax and jute counts as basis.			Irish wet-spun flax or lea counts as basis.		
Pounds per spyndle of 14,400 yards.	Linen leas of 300 yards.	Cotton hanks of 840 yards.	Linen leas of 300 yards.	Pounds per spyndle of 14,400 yards.	Cotton hanks of 840 yards.
1	48.00	17.143	1	48.00	0.357
1½	32.00	11.43	2	24.00	.71
1¾	27.43	9.79	3	16.00	1.07
2	24.00	8.57	4	12.00	1.43
2¼	21.33	7.62	5	9.60	1.79
2½	19.20	6.86	6	8.00	2.14
2¾	17.45	6.23	7	6.86	2.50
3	16.00	5.71	8	6.00	2.86
3½	13.71	4.89	9	5.33	3.21
4	12.00	4.28	10	4.80	3.58
4½	10.66	3.81	12	4.00	4.29
5	9.60	3.43	14	3.43	5.00
5½	8.73	3.12	16	3.00	5.71
6	8.00	2.86	18	2.67	6.43
6½	7.38	2.64	20	2.40	7.14
7	6.86	2.45	22	2.18	7.86
7½	6.40	2.29	25	1.92	8.93
8	6.00	2.14	30	1.60	10.71
8½	5.65	2.02	32	1.50	11.43
9	5.33	1.90	35	1.37	12.50
9½	5.05	1.80	40	1.20	14.29
10	4.80	1.71	45	1.07	16.07
10½	4.57	1.63	50	.96	17.86
11	4.36	1.56	55	.87	19.64
11½	4.17	1.49	60	.80	21.43
12	4.00	1.43	65	.74	23.21
13	3.69	1.32	70	.69	25.01
14	3.43	1.22	75	.64	26.80
15	3.20	1.14	80	.60	28.57
16	3.00	1.07	85	.56	30.36
18	2.67	.95	90	.53	32.13
20	2.40	.86	95	.51	33.93
22	2.18	.78	100	.48	35.71
24	2.00	.71	110	.44	39.29
26	1.85	.66	120	.40	42.86
28	1.71	.61	130	.37	46.43
30	1.60	.57	140	.34	50.00
32	1.50	.54	150	.32	53.57
34	1.41	.50	160	.30	57.14
36	1.33	.48	170	.28	60.71
38	1.26	.45	180	.27	64.29
40	1.20	.43	190	.25	67.86
42	1.14	.41	200	.24	71.43
44	1.09	.39	250	.19	89.29
46	1.04	.37	300	.16	107.14
48	1.00	.36	350	.14	125.00
50	.96	.34	400	.12	142.86
60	.80	.29			
70	.69	.24			
80	.60	.21			
90	.53	.19			
100	.48	.17			
150	.32	.11			
200	.24	.089			
250	.19	.069			
300	.16	.057			
350	.14	.049			
400	.12	.043			

VARIATIONS IN SYSTEMS.

In the Irish linen trade the sett of the warp in the reed is based on the number of hundreds of splits, two ends in a split, in a standard width of 40 inches; thus 8^{00} linen in Ireland means that it was woven with a reed having 800 splits, or 1,600 ends, in a width of 40 inches. In Scotland the Scotch ell of 37 inches is the standard breadth for linen and jute fabrics. In the West of Scotland, or Glasgow, scale, the reed is indicated by the number of hundreds of splits, two ends to the split, in this standard width of 37 inches, but this scale is used only for cotton. The East of Scotland scale is that used for most linen and for jute fabrics in Scotland, and in this case the hundreds of splits are divided into five parts, called porters, and the sett of the warp in the reed is indicated by the number of porters of 20 splits, or 40 ends, in the standard width of 37 inches. For instance, if a cloth is woven with a reed having 1,000 splits, embracing 2,000 ends, in 37 inches of width, it is called in the East of Scotland trade a 50-porter cloth; if the reed has 800 splits in 37 inches it is called a 40-porter cloth, etc.

The East of Scotland scale is that generally used in the Scottish linen trade, but there are also some special scales. Damask manufacturers frequently use the old method of denominating the reed by the number of beers, or porters, of 40 ends each in the full width of the cloth, while drill is frequently based on the number of beers of 40 ends each in a standard width of 30 inches. The more rational method of giving the warp ends per inch multiplied by the reed width is favored by some, but rarely used.

In the textile terminology of the United Kingdom, whether in the linen, the cotton, the woolen, or other industry, there has always been great confusion between the systems used, not only in different sections but between towns in the same section.

In Ireland the sett of the weft in linens is indicated by the number of picks or shots under a 37-inch glass—that is, the number of picks in thirty-seven two-hundredths, or 0.185, of an inch. This system is used in some sections of the Scottish linen trade, but coarse goods are more often given in terms of picks per inch, owing to the impracticability of giving picks of coarse yarn in so small a space as 0.185 of an inch.

COMMERCIAL QUOTATIONS.

Russian flax is used almost exclusively in the Scottish dry-spinning trade, and the following are the Dundee prices on January 1, 1913, of the qualities regularly quoted in the Dundee Prices Current and Trade Report:

Class.	Price per ton.	
	English currency.	American currency.
	£ s. £ s.	
Riga:		
Livonian K	32 0 to 32 10	$155.73 to $158.16
Courish K	30 0 to 30 10	146 to 148.43
Hoffs D	27 0 to 27 10	131.40 to 133.83
St. Petersburg:		
Bejetsky	44 10 to 45 10	216.56 to 221.43
Yarapol, first sort	37 0 to 37 10	180.06 to 182.49
Sytcheffka	36 0 to 37 0	175.19 to 180.06
Dorpat D	39 10 to 40 0	192.23 to 194.66
Pernau D	36 0 to 36 10	175.19 to 177.63
Kama ½ and ½ Tow	41 10 to 42 10	201.96 to 206.83
Novgorod 7/3	42 10 to 43 0	206.83 to 209.26
Mologyn ½ and ½	39 10 to 40 0	192.23 to 194.66

These prices are ex warehouse, 3 per cent cash in 14 days; or for shipment, less 1¼ per cent for cash, or 3 months net.

FLAX AND TOW YARNS.

The range of dry-spun yarns for ordinary linens is from 1½ to 4½ pounds per spyndle, while canvas yarns run from 4½ to 20 pounds per spyndle. The following are the Dundee prices per spyndle on January 1, 1913, of the flax and tow yarns regularly quoted in the Dundee Prices Current and Trade Report:

Yarns.	Weft, per spindle.		Warp, per spindle.	
	English currency.	American currency.	English currency.	American currency.
Flax yarns:	*s. d.* *s. d.*	*Cents.*	*s. d.* *s. d.*	*Cents.*
2 pounds	1 9½ to 1 10	43.6 to 44.6	2 2 to 2 3	52.7 to 54.7
2¼ pounds	1 10½ to 1 11	45.6 to 46.6	2 2 to 2 3	52.7 to 54.7
2½ pounds	2 1 to 2 1½	50.7 to 51.7	2 2½ to 2 3½	53.7 to 55.7
2¾ pounds	2 2 to 2 2½	52.7 to 53.7	2 3 to 2 5	54.7 to 58.8
3 pounds	2 3 to 2 3½	54.7 to 55.7	2 5 to 2 6	58.8 to 60.8
3½ to 6 pounds	9⅛ to 0 9¼	18.3 to 18.5	9½ to 0 9¾	19.0 to 19.5
Tow yarns:				
3 pounds	2 1	50.7	2 3 to 2 4	54.7 to 56.8
3½ pounds	2 2½ to 2 3	53.7 to 54.7	2 5 to 2 6	58.8 to 60.8
4 pounds	2 3½ to 2 4	55.7 to 56.8	2 6 to 2 7	60.8 to 62.9
5 pounds	2 7 to 2 7½	62.9 to 63.9	2 10 to 3 0	68.9 to 73.0
6 pounds	2 10 to 2 10½	68.9 to 69.9	3 0 to 3 3	73.0 to 79.1

Yarn weighing 3 pounds per spyndle is usually taken as the standard and prices are based on this number.

COMPARATIVE PRICES OF RAW MATERIALS AND YARNS.

In buying and selling at Dundee, flax and tow are always quoted by the English ton of 2,240 pounds. The imported fine wet-spun yarns are quoted by the bundle of 60,000 yards (equal to 4⅙ spyndles), less 5 per cent discount delivered; but dry-spun flax and tow yarns are quoted by the spyndle of 14,400 yards, less 3 per cent prompt cash.

According to the Dundee Prices Current and Trade Report the following were the comparative prices at Dundee on prominent flaxes and tows and on some standard flax and tow yarns on the 1st day of January for the past 13 years:

Years.	Flax.			Tow.	Flax yarns.		Tow yarns.	
	Bejetsky.	Pernau.	Hoffs.	Novgorod 7/3.	2½-pound weft.	3-pound warp.	3-pound weft.	5-pound warp.
					Cents.	*Cents.*	*Cents.*	*Cents.*
1901	$221.43	$194.66	$146.00	$197.09	39.5	54.7	34.5	47.6
1902	172.76	146.00	102.20	148.43	37.5	45.6	33.4	44.6
1903	148.43	131.40	94.90	143.56	35.5	43.6	35.5	48.7
1904	228.73	182.49	136.26	199.53	39.5	48.7	43.6	56.8
1905	160.59	148.43	99.76	150.86	39.5	46.6	38.0	51.7
1906	197.09	158.16	107.06	170.33	41.6	48.7	40.6	54.7
1907	182.49	143.56	99.76	160.59	44.6	51.7	48.7	56.8
1908	177.63	116.80	73.00	143.56	47.6	52.7	42.6	58.8
1909	170.33	126.53	85.16	155.73	38.5	44.6	37.5	50.7
1910	194.66	152.08	107.06	155.73	40.6	49.7	37.5	50.7
1911	228.73	180.06	136.26	180.06	48.7	57.8	41.6	53.7
1912	194.66	155.73	111.93	158.16	46.6	56.8	41.1	56.8
1913	216.56	175.19	131.40	206.83	50.7	58.8	50.7	68.9

DETAILS OF SCOTTISH FLAX GOODS.

Tables published by William Leggatt, of Dundee, furnish interesting data as to some of the goods made in large quantities in Scottish flax factories. He states that all canvas for His Majesty's Navy must be made wholly from the longs of the best British, Irish, Riga, or Reval flax, or from the best long white Dutch, Flemish, or Friesland flax; that all such canvas is 18 or 24 inches wide, the former being used only for a few special sails.

ROYAL NAVY CANVAS.

There are eight classified numbers of 24-inch Royal Navy canvas, which is used for sails, as follows:

No.	Reed.	Warp ends.	Shots.	Length warp.	Length cloth.	Weight cloth.	Yarn counts.	
							Warp.	Weft.
				Yards.	*Yards.*	*Pounds.*	*Pounds.*	*Pounds.*
1	24¾	1,300	15½	48½	39	46	6½	18½
2	24¾	1,308	16	48½	39	43	6	17
3	24¾	1,320	17½	48½	39	40	5½	15
4	24¾	1,324	19½	48½	39	36	5	12
5	24¾	1,324	20	48	39	33	4½	11
6	26	1,392	22	48	39	30	4½	10
7	28	772	25	49	40	27	6½	6½
8	28	776	27	48	40	23	5½	5½

MERCHANT NAVY CANVAS.

The 24-inch Merchant Navy canvas used by the Admiralty for awnings, etc., is as follows:

No.	Reed.	Warp ends.	Shots.	Length warp.	Length cloth.	Weight cloth.	Yarn counts.	
							Warp.	Weft.
				Yards.	*Yards.*	*Pounds.*	*Pounds.*	*Pounds.*
1	26	1,364	14½	52½	42	48	6½	20
2	26	1,368	15	52½	42	44	6	19
3	24½	1,304	17	52½	42	41	5½	15
4	24¾	1,312	18	52½	42	38	5	12
5	24¾	1,320	20	52½	42	35	5	9
6	26	1,392	22	52½	42	32	4½	7
7	26	1,420	24	52	42	29	3½	6½

The Royal Navy canvas is required to have a testing strength about a third higher than that for Merchant Navy canvas. The yarns for navy canvas are prepared entirely without chlorine; they are twice boiled with ashes and carefully washed after each boiling with water to eliminate the vegetable matter so far as possible. The Royal Navy canvas is made without stripes, and that for the Merchant Navy class has one stripe.

The United States Government Navy canvas is stated to be also of a very high quality, being made wholly from flax; but it is of a different make, being only 20 inches wide. The numbers from 1 to 5 are made with double warp and two-ply twisted weft, while Nos. 7 and 8 are made from single yarn. They also have a blue stripe,

which is $1\frac{7}{8}$ inch from the selvage of No. 1 and varies to $1\frac{1}{8}$ inch from the selvage for No. 8. The bolts are made 40 yards long, with weights as follows: No. 1, 47 pounds; No. 2, 44 pounds; No. 3, 41 pounds; No. 4, 37 pounds; No. 5, 34 pounds; No. 6, 31 pounds; No. 7, 28 pounds; No. 8, 24 pounds.

BLEACHED CANVAS.

The 24-inch bleached canvas, starched, is classified in seven numbers, as follows:

No.	Reed.	Warp ends.	Shots.	Length warp.	Length cloth.	Weight cloth.	Yarn.	
							Warp.	Weft.
				Yards.	*Yards.*	*Pounds.*		
1	26	1,360	16	45	36	$37\frac{3}{4}$	6-lb. tow	16-lb. tow.
2	26	1,364	18	45	36	$34\frac{3}{4}$	...do.....	14-lb. tow.
3	24	1,268	18	45	36	32	...do.....	12-lb. tow.
4	24	1,272	$18\frac{1}{2}$	45	36	$29\frac{1}{4}$	...do.....	11-lb. tow.
5	24	1,280	20	$44\frac{1}{2}$	36	$26\frac{1}{4}$	...do.....	9-lb. tow.
6	24	1,288	24	$44\frac{1}{2}$	36	$23\frac{3}{4}$	...do.....	5-lb. tow.
7	24	1,296	24	44	36	21	...do.....	Do.

OTHER FLAX GOODS.

Some other Scottish makes of flax goods are shown in the following table:

TARPAULIN.

Reed.	Width.	Warp ends.	Shots.	Length warp.	Length cloth.	Weight cloth.	Yarn.	
							Warp.	Weft.
				Yards.	*Yards.*	*Pounds.*		
22	27	1,316	15	$68\frac{1}{2}$	56	$49\frac{1}{2}$	4-lb. flax.....	14-lb. tow.
22	30	1,444	15	$68\frac{1}{2}$	54	54	.....do.....	Do.
22	30	1,444	16	$68\frac{1}{2}$	54	58	.....do.....	Do.
20	30	1,320	19	71	55	57	5-lb. tow.....	10-lb. jute tow.
22	30	1,450	18	71	55	61	.....do.....	$11\frac{1}{2}$-lb. flax.
20	30	1,320	16	71	56	54	4-lb. flax.....	15-lb. tow.
20	30	1,320	$16\frac{1}{2}$	71	56	57	.....do.....	Do.

DUCK.

32	27	992	15	175	150	91	$4\frac{1}{4}$-lb. flax.....	$4\frac{1}{2}$-lb. flax.
32	$27\frac{1}{2}$	1,016	15	$182\frac{1}{2}$	152	94	4-lb. flax.....	5-lb. tow.
38	27	1,200	15	164	140	81	.....do.....	4-lb. flax.
40	27	1,260	$15\frac{1}{2}$	127	105	$63\frac{3}{4}$	.....do.....	Do.
42	27	1,320	$15\frac{1}{2}$	127	105	$63\frac{3}{4}$	.....do.....	Do.
32	26	930	17	167	137	$52\frac{3}{4}$	-lb. flax.....	$2\frac{1}{2}$-lb. flax.
34	26	1,016	$17\frac{1}{2}$	170	140	58	18-lea flax.....	20-lea flax.
36	26	1,068	18	172	142	62	.....do.....	18-lea flax.
40	26	1,180	19	172	142	62	20-lea flax.....	20-lea flax.
42	26	1,236	18	177	147	70	18-lea flax.....	18-lea flax.
44	26	1,308	18	180	150	70	.....do.....	Do.
46	26	1,334	18	180	150	68	20-lea flax.....	20-lea flax.
48	26	1,410	20	134	104	51	.....do.....	22-lea flax.
53	26	1,544	22	134	104	42	22-lea flax.....	25-lea flax.

DOWLAS.

28	27	872	14	$182\frac{1}{2}$	152	91	$4\frac{1}{2}$-lb. flax.....	5-lb. flax.
28	40	1,280	15	180	155	.....	$3\frac{1}{2}$-lb. flax.....	$3\frac{1}{2}$-lb. tow.
30	40	1,380	16	$182\frac{1}{2}$	155	.....	.....do.....	Do.
32	50	1,820	17	182	155	66	3-lb. flax.....	3-lb. flax.

FLAX SHEETING.

Reed.	Width.	Warp ends.	Shots.	Length warp.	Length cloth.	Weight cloth.	Yarn.	
							Warp.	Weft.
				Yards.	*Yards.*	*Pounds.*		
34	42	1,628	17	182½	152	124	4-lb. flax	3-lb. flax.
38	41	1,780	15	185	152	91½	3-lb. flax	2-lb. flax.
32	44	1,594	16	85	71	65	do	4-lb. flax.
26	40	1,194	14	177½	164	86	do	3½-lb. tow.
28	40	1,280	15	180	164	90	do	Do.
30	40	1,380	16	180	164	94	do	Do.
73	42	3,448	37	155	155	.....	70-lea flax	75-lea tow.
78	42	3,690	40	155	155	.....	80-lea flax	90-lea tow.

The figures for the reed indicate, as previously explained for the East of Scotland scale, the number of porters of 20 splits, 2 ends to a split, in the standard width of 37 inches.

OPERATIVES AND WAGES.

Of the 95,950 operatives engaged in the linen industry in 1904, 62,194 were employed in Ireland, 27,523 in Scotland, and 6,233 in England. In 1907 the total had increased to 100,475, but there was practically no change in the number employed in Scotland and England, and the increase was due to Ireland, which then numbered 67,027.

The latest Government figures as to wages in the linen industry of the United Kingdom are those for 1906, which give the average weekly wages of full timers in the various sections, as follows:

Operatives.	Ireland.		Scotland.			England.	United Kingdom.
	Belfast district.	Other districts.	Fife-shire.	Forfar-shire.	Other districts.		
Men:							
Roughers	$5.27	$4.18	$5.35	$5.39	$6.00	.....	$5.15
Weavers	4.05	3.49	.....	.....	.....	$4.30	3.57
All men	6.37	4.54	6.00	5.27	5.96	5.53	5.43
All lads and boys	1.86	1.60	2.09	2.11	2.13	2.05	1.86
Women:							
Spinners	2.53	2.29	2.39	2.43	2.68	.....	2.45
Reelers	2.74	2.39	2.41	2.82	2.98	.....	2.61
Winders	2.74	2.29	2.30	3.14	3.14	2.80	2.74
Weavers	2.82	2.45	2.96	2.96	3.47	2.61	2.80
All women	2.63	2.37	2.90	2.80	2.86	2.63	2.61
All girls	1.56	1.44	1.68	1.76	2.03	1.60	1.60
Total, all workers	2.86	2.68	3.26	3.00	3.34	2.96	2.92

Wages in the flax industry of Scotland are governed largely by those paid in the larger jute industry, and in flax manufacturing the operatives average higher in Scotland than in Ireland, with the exception of the men in the Belfast section, where the higher average is due to the large number of higher-paid roughers and sorters. It is estimated that since these tables were compiled the average wages in the Irish industry have advanced about 6d. (12 cents), and in the Scottish about 1s. (24 cents), so that the average wages in Scotland are proportionately higher than they were in 1905.

JUTE INDUSTRY IN SCOTLAND.

Jute is the cheapest fiber in commercial use to-day and, excepting cotton, the most extensively employed. The Bureau of the Census in 1909 estimated the world's production of the principal fibers as follows: Cotton, 8,505,191,000 pounds; jute, 2,918,000,000 pounds; wool, 2,763,310,000 pounds; flax, 1,872,127,000 pounds; hemp, 1,453,186,000 pounds; silk, 85,048,000 pounds.

Jute is grown almost exclusively in the Province of Bengal in India and is the only one of the six great textile fibers that is a monopoly of a single country. Cotton, wool, flax, and silk, while used for many purposes, find their greatest use as clothing; hemp is distinctively a cordage material, while jute is a wrapping and sacking material.

Jute is the weakest, most perishable, least lustrous, and least showy of all fibers in use to-day. It owes its lead among the lower textile fibers to its cheapness, which is due mainly to its great production per acre and to the ease with which it can be prepared, spun, and woven under modern methods.

EARLY HISTORY OF INDUSTRY.

Jute was used in India for a long time in making cordage, sacking, and coarse clothing by hand, but as a world fiber it ranks among the youngest. The jute industry of to-day grew out of the flax, tow, and hemp industries, which had existed in and around Dundee for centuries, and Dundee was the first to apply machinery to its manufacture. In 1824 the East India Company shipped some jute to Dundee to see what could be made of it; but the samples were harsh, brittle, and dirty, and after one or two perfunctory trials the flax industry refused to have anything to do with such uninviting material. Its great length was considered one of the chief drawbacks; but in 1832, after further experiments, the long jute fiber was teased in a breaker and reduced to tow, in which shape it was used to mix with flax. The first trials at spinning it separately were a failure, and the adulteration of flax with jute was regarded as so obnoxious that "warranted free from Indian jute" became a standard condition of business in the Dundee flax trade of the time. It was not until 1835 that the first yarns of pure jute were sold on the Dundee market, and it was not until about 1838, after the invention of a machine for softening the fiber before working it and after various adaptations and improvements had been made in the existing flax machinery, that the jute industry may be said to have become firmly established. By 1855, however, the manufacture of the new fiber had proved so successful and profitable that a great majority of the Dundee spinners and weavers changed from flax to jute. To-day there are only three

firms at Dundee that spin flax, and two of these spin almost as much jute as flax.

Dundee had an absolute monopoly of the world's machine manufacture of jute for some years following 1838, and it was not until 1855 that the first jute machinery was sent to India. In 1861 the first small jute mill was started on the Continent, and for a considerable number of years thereafter Dundee maintained its position as the jute center of the world. Dundee really represents the jute industry of the United Kingdom, for the output of the few isolated jute mills at Aberdeen and other points forms a negligible part of the total. The mills on the Hoogly have checked the growth of the mills on the Tay, but next to Calcutta the city of Dundee is still the largest single center and leads in the production of the finer yarns and cloths.

PRINCIPAL PRODUCTS.

The principal products here have always been yarns, hessians (burlaps), D. W. (double-warp) bagging and tarpaulin, and twilled sacking, with sacks, bags, and covers made therefrom. The chief product has always been hessians, which in the United States are called burlaps. At first Dundee manufactured for the hessian trade and Calcutta for the coarse bagging trade, but within more recent years Calcutta has become a formidable rival in hessians, and a majority of the Indian looms are now on this material; moreover, they are yearly engaging further in the manufacture of the finer grades. Dundee goods, however, are considered of better quality and usually bring better prices than Calcutta hessians of the same general make. The Indian mills also prefer to work on large orders, while Dundee will fill small orders of more widely varying constructions and widths. A small proportion of the jute handled at Dundee is hackled and prepared in the same way as flax and made into line yarns for window drapery, paddings, etc.

On account of the cheapness of the fiber, new uses have been found for it from time to time, and as the manufacture of the commoner grades has been threatened by the extension of the industry in India or on the Continent, Dundee manufacturers have been compelled to turn their attention to specialties to supplement the ordinary run of fabrics. It was found that jute could be dyed in very delicate shades, and though at first considered unbleachable methods have been found of bringing it to a considerable degree of whiteness. It was early used in carpet manufacture and this branch has been extended and perfected. Not only stair carpets and mattings but Brussels, Wilton, Scotch, and other carpets are now made partially and in some cases wholly of jute; rugs, towels, upholstery cloths, etc., are also manufactured. Another avenue opened up was in the manufacture of wide widths of hessian cloth for the foundation of linoleum and other floorcloths, and in the last 10 years or so many wide looms have been substituted for narrower looms whose product had become increasingly difficult to market. Great development in the spinning of jute yarns for use as cords, twines, and even ropes has taken place within the last few years, and this is now an important branch in many Dundee mills.

TREND OF INDUSTRY SINCE AMERICAN CIVIL WAR.

The basis of the present extensive manufacture of jute at Dundee was laid at the time of the American Civil War, which made cotton so high that there was a search for cheaper materials. It was found that jute was suitable for bags and many other articles for which cotton had theretofore been used. Dundee manufacturers promptly took advantage of the opportunity thus presented, and the great fortunes then made enabled them to put the industry on a sound footing. Later they also invaded the market for tow bags and succeeded in supplanting flax as well as cotton in many lines. Large fortunes have been made in the Dundee industry, but its advance has been checked by the huge and rapidly expanding industry on the Hoogly, not to mention its extension in many of the principal markets on the Continent and elsewhere. It has had to fight for its existence and there have been many ups and downs.

In the early years of the present century there was such a lull in the jute trade that by 1905 much machinery was idle, but in 1906 the world seemed suddenly to become hungry for jute fabrics again, and 1906 and 1907 were periods of great prosperity. There was then another quiet period, and 1910 and the first six months of 1911 were a period of great stagnation, which resulted in short time and stoppage of machinery, not only in Dundee but in India and on the Continent. Spinners and weavers who continued running, mostly on short time, made largely to stock, and the demand seemed to become weaker and weaker, especially for hessians. Probably never before were the stocks so immense or was there more idle machinery. At last, however, it reached a point where demand overtook production, buyers woke up, and the demand once started appeared insatiable. By the end of 1912 the immense stocks had not only disappeared but many manufacturers were sold ahead to the end of 1913 and some beyond that time. Dundee holds the opinion that on top of the short time the prolonged strike in the Dundee works was the finishing touch that brought supply and demand to an equalizing point, and introduced a period of unexampled prosperity. This spurt has not only been one of the most successful in the history of the trade, but at the present time (May, 1913) is still very strong, and no machinery is idle for which hands can be obtained. Even greater results would probably have been attained had not the stoppage of a large Dundee shipbuilding works in 1912 caused the removal of many families, so that there have not been sufficient operatives to meet the demands of the factories.

RAW MATERIALS.

In order of value, the principal articles with which India partially pays the United Kingdom for Manchester cottons, etc., are grain, tea, seeds, raw jute, hides and skins, wool, cotton, and jute manufactures. Raw jute, therefore, occupies fourth place in the export trade of India with the United Kingdom, while manufactured jute occupies eighth.

Dundee records show an import of 300 tons of raw jute in 1836 and of 1,136 tons in 1838. Prior to 1853 the statistics of the United Kingdom lumped raw jute with hemp, but in that year there was shown

an import of 13,779 tons of raw jute, of a value not stated, with a reexport of 374 tons. The quantity and value of the jute imported into the United Kingdom and the amount retained for consumption have been as follows:

Years.	Imports.			Reexports.	Retained for consumption.
	Quantity.	Total value.	Value per pound.		
	Tons.		*Cents.*	*Tons.*	*Tons.*
1855	26,965	$2,176,138	3.60	469	26,496
1860	40,839	3,216,333	3.52	1,816	39,023
1870	118,835	11,323,908	4.25	21,286	97,549
1880	231,945	19,557,490	3.57	54,425	177,520
1890	369,958	23,952,869	2.89	109,778	260,180
1900	280,919	20,120,004	3.19	107,938	172,981
1901	321,331	21,053,297	2.92	121,965	199,366
1902	414,553	25,797,010	2.77	122,700	291,853
1903	240,090	15,752,238	2.89	80,583	159,507
1904	306,433	20,428,555	2.97	103,266	203,177
1905	336,855	27,948,076	3.70	110,180	226,675
1906	369,789	40,592,606	4.90	138,853	230,936
1907	363,835	39,736,212	4.87	138,422	225,413
1908	354,028	28,633,620	3.61	104,853	249,175
1909	304,660	22,434,443	3.29	105,231	199,429
1910	296,720	22,727,845	3.42	95,230	201,490
1911	300,959	29,180,318	4.33	109,657	190,302
1912	384,984	40,597,175	4.71	140,396	244,588

These figures show that the consumption of jute in the United Kingdom, while varying from year to year, has been practically stationary for the last 30 years. In the last 12 years—1901 to 1912, inclusive—the jute retained in the United Kingdom has amounted to 2,621,918 English tons, or an average of 218,493 tons a year.

SHIPPING ROUTES AND FREIGHT CHARGES.

The great bulk of the jute consumed at Dundee comes direct from India, while the imports at London are mainly for reshipment to the Continent. Of 226,309 tons of jute imported at Dundee in 1912, 211,070 tons came in steamers direct from Calcutta and Chittagong, 13,006 tons in coasting vessels from London or other points, 1,903 tons from Continental ports, and 330 tons by rail.

In the course of the season usually about 10 steamers from Chittagong and about 40 from Calcutta arrive loaded with jute. These vessels are from 2,000 to 5,300 gross tons in size and bring at a trip from 5,000 to 50,000 bales, averaging about 20,000 bales a trip. Most of the steamers take from 36 to 42 days for the run from Calcutta to Dundee, the speedier ones with favorable circumstances sometimes making it in 33 days, while occasionally one takes over 50 days.

Some raw jute is exported from Dundee to the United States and elsewhere, but the reexports from the United Kingdom consist principally of jute landed at London for reshipment to Continental customers. Of 109,657 tons of raw jute reexported from the United Kingdom in 1911, 27,427 tons went to France, 23,487 to Germany, 18,076 to Belgium, 14,390 to the Netherlands, 5,793 to Mexico, 5,131 to Spain, 4,783 to Russia, 3,795 to the United States, 3,305 tons to Brazil, and the small remainder to Norway, Sweden, and other countries.

Shipments of a new crop from India start in quantity about September, and the month of heaviest shipment is October, followed by November, September, and December. According to freight rates published by the Indian Government, in the last 30 years there has been a lowering of rates on most articles, especially those from Bombay, but rates on jute have increased. The lowest freight rates from Calcutta to London in October, the month of heaviest shipments, have been as follows for various years: 1890, $6.69; 1895, $4.87; 1900, $6.69; 1905, $4.26; 1910, $6.39; and 1911, $7.91. Freights vary considerably during a season, according to the law of supply and demand, etc. For instance, during the season of 1911–12 the rates from Calcutta to Dundee averaged around 30s. ($7.30), but varied from a minimum of 22s. 6d. ($5.47) to a maximum of 45s. ($10.95). However, there seems to be a strong tendency upward. Dundee freights are sometimes the same as London freights, but usually about a shilling higher. Calcutta freight rates on jute January 1, 1913, were $8.52 to London, $8.82 to Dundee, and $9.43 to Hamburg. Jute bales weigh about 400 pounds and measure 10 cubic feet. Most freight rates are quoted per ton of 2,240 pounds or 40 cubic feet, at ship's option, but in the case of jute the rates are based on five bales, these weighing only 2,000 pounds but measuring 50 cubic feet.

GRADING OF JUTE.

The raw jute shipped from Calcutta is of many qualities, but in commerce it is usually classed under four general heads: Seragunge, produced in the Pabna and Mymensingh districts; Naraingunge, from the Dacca district; Daisee (or Desi), mainly produced in the districts around Calcutta; Dowrah (or Deora), from Bakerganj and Faridpur. Daisee is used at Dundee principally for hessians, while Dowrah is used for cordage. Uttariya, which is generally classed as the finest variety of jute, comes from the northern portions of Seragunge and that neighborhood, while Deswald, which is the next best variety, is also a Seragunge jute. Before pressing these different varieties are sorted and divided into three grades—fine, medium, and common. Each shipper has his registered trade-marks for the different grades from different sections, and Dundee merchants and spinners buy on their knowledge of the standard guaranteed by the trade-marks of the different shippers, making due allowance for the standing of the shipper.

The finest jute imported comes under the "RFC" range of trade-marks; after these are the "First Marks," that is, the first quality marks of the best shippers; then the "Daisee" assortment of marks; then "ordinary firsts," and so on down to rejections and cuttings, or jute butts. There are numerous registered trade-marks, which usually consist of black or red letters with or without certain geometrical figures, such as triangles, double triangles, circles, diamonds, and hearts, and each represents to the trade a certain standard of jute.

QUOTATIONS ON STANDARD MARKS.

The standard marks regularly quoted by the jute importing firm of W. F. Soutar & Co., of Dundee, for instance, are as follows, the

prices being from their circular of February 6, 1913, for the previous month of January:

Marks.	Price.
RF C D 4	£. s. to £. s.
RF Davids	----------
D ✲	----------
RF D	30 10 to 31 0.
RF SB	23 0 to 23 10.
D Red. BULLUB CHUNDER DS	26 5 to 27 0.
Red COM & CO. Green Bul lub Ram	22 15 to 23 10.
Bul lub CDM & CO. KALI	19 15 to 19 10.
Red BULLUB 1 2 Red GHOSE DAISEE 2	22 15 to 24 5.
Rejections (Rallis and Davids)	18 0 to 18 10.
Rejections (natives)	14 0.
Cuttings (spinning)	16 0 to 16 10.

ARBITRATIONS.

Usually on arrival at Dundee 10 per cent of the bales in a shipment are weighed and examined, but owing to much trouble with shipments in recent years, which has led to hundreds of arbitrations in a season, shipments are now examined more closely and spinners now often wish to examine the whole lot before accepting. A standing complaint of the Dundee trade is that in a shipment of a certain standard mark there will nearly always be found a certain number of bales of a lower-grade mark, and that, according to decisions of the courts, importers are compelled to accept these bales to fill out their bill of lading quantity. An allowance is made for the lower-grade material, but if the spinner is unable to use the latter and has to sell it and make additional purchases of the material he requires, this allowance is not considered much of a compensation. The court's decision still stands, but strenuous efforts are being made to get it reversed.

Sometimes there are cases of false-packed bales and not infrequently the jute is found to be heart damaged through having been kept without ventilation in the hold of the vessel. The damp heat to which it is unavoidably subjected on the long voyage from Calcutta tends to set up fermentation. If the cargo is properly looked after and ventilated this does not occur, except where the jute has been watered before shipment, in which case nothing the crew can do will prevent damage.

Great losses are sustained annually through the watering of jute fraudulently to gain weight and no representations on the part of either Calcutta or Dundee associations have yet been able to lessen this. Moistening of fiber that has once been dried causes it to lose both strength and color rapidly, and even if it does not rot so as to become unworkable the value is greatly depreciated. It is claimed that the weight fraudulently gained by watering amounts to the equivalent of several hundred thousand bales annually, and the practice is so widespread that in 1910 the Director of Agriculture in India, much to the indignation of the trade it may be noted, revised his estimate of the jute outturn by adding 5 per cent for moisture. The damp jute received is not confined to native marks entirely, for the marks of even the most prominent and reliable European firms at Calcutta are not exempt, as they seem to be unable to have their jute delivered every season unwatered. The original cultivator, the humble ryot, sells his jute dry and it is claimed that the watering is done by the "bipari," or middleman, who gains additional weight and profit in this manner, frequently adding as much as 20 per cent of water and sand. In the case of first marks, if the allowance made by the experts who are called in to arbitrate the case is 20s. or over per ton, the Dundee purchaser has the option of taking it at the allowance or of invoicing it back at the market price, and shipments are not infrequently invoiced back in this way.

In the matter of watering, of shipping fiber inferior to that ordered, etc., there seems to be much more trouble in the jute trade than in the cotton trade, even with cotton shipped from India and Egypt, where watering is often done openly; not to mention the fact that the watering of jute, owing to its perishable nature, is a much more serious matter than in the case of cotton.

WAREHOUSING.

On arrival at Dundee jute is usually stored in public warehouses by the importing merchant or spinner and a portion is transferred to the mill warehouse as required. The charge made by the public warehouses for storage and insurance varies, but is usually about 6d. per ton per month.

Jute is very inflammable and many fires occur in the close-packed warehouses, in which case the danger is increased by the power jute has of absorbing water and expanding in volume. Jute will absorb water equal to its own weight and in doing so will expand enormously, an increase in bulk of 50 per cent being quite common. One of the most disastrous fires occurred December 24, 1912, in a jute warehouse belonging to Scott, Sons & Co. The flames not only caused damage to the extent of some £75,000, but the expansion of the water-soaked bales burst the walls of the warehouse and destroyed a near-by cottage, killing four children. Fires also frequently occur in cargoes of jute en route.

FINANCING OF IMPORTS, ETC.

Raw jute is imported at Dundee partly by merchants for sale to spinners or for their account and partly by the spinners direct. The largest jute importers are Cox Bros. (Ltd.), James Scott & Sons (Ltd.), J. K. Caird, J. & A. D. Grimond (Ltd.), H. Walker & Sons

(Ltd.), John Sharp & Sons (Ltd.), D. Pirie & Co., J. N. Kyd & Co., Thomson, Shepherd & Co. (Ltd.), T. S. Ross & Co., Malcolm, Ogilvie & Co. (Ltd.), Buist Spinning Co. (Ltd.). This list embraces all those who are recorded as importing over 30,000 bales each during the past season, Cox Bros. (Ltd.) alone taking 126,510 bales.

Raw jute is an extremely cheap fiber and as the yarn and goods made therefrom are correspondingly cheap, the spinner's or manufacturer's profit depends largely upon the average level of prices at which he is able to obtain his supplies. Within recent years there has been increasing speculation in the raw jute market, and profits frequently depend more largely on the foresight or daring of the spinner in getting his jute at the right time than on his skill or low cost in manufacturing.

Under certain circumstances the spinner may find it more advantageous to buy a portion of his jute on spot, but the bulk of it is bought through local brokers for shipment on draft or cash on arrival. With the exception of the primary transaction in India where the baler settles with the Bengal native growers in rupee money, the jute is paid for by bills of exchange, usually drawn at three months' sight by the shippers. Sometimes these bills are drawn direct upon the buyers for payment against delivery of the accompanying bills of lading, invoices, and marine insurance policies, but as a rule the bills with relative shipping documents are drawn upon the London office of the Scottish bank with which the spinner or merchant keeps his local account, the documents being deliverable on acceptance of the draft. These bills are converted into cash on the other side by being sold, at the ruling rate of exchange, to one or other of the Indian banks, which forward them to their offices or correspondents in London. On arrival of each mail the drafts are presented for acceptance to the London offices of the Scottish banks; the local banks are advised without delay of their arrival and receive instructions from their customers as to acceptance or payment. If the customer has unemployed capital he may secure a fair return on his money by electing to pay a number of the drafts under rebate.

Except in the case of drafts for accounts of merchants doing a cash-on-arrival business, the London offices are instructed to accept the bulk of the drafts, or in other words to engage to pay them at maturity. The holders of the draft, on obtaining the bank's acceptance or payment under rebate, surrender the shipping documents, which are then forwarded to the local Dundee banks, where they are held pending the arrival of the steamers. By arrangement with his banker the customer may get the documents so that he may operate delivery and store the jute, or pass on the documents to his buyer for cash. In many cases the jute is stored in independent warehouses in the name of the banks, as security to them for present or future advances. Transactions of the nature described run into huge figures in the course of a season, and by interposing their credit for account of their numerous customers the banks play a most important part in financing the stocks of jute required. In Scotland, as in England, banks rarely lend to manufacturers or merchants on notes; instead they grant a fixed overdraft credit, the amount of which depends upon the free assets of the customer as well as upon his character and business capacity, and they usually require that he has transactions with no other bank.

Not only do the banks play an important part in the financial operations by which the jute supply is bought and paid for, but they are also a valuable medium by which payment is effected for manufactured goods sold locally through merchants or brokers. The settlement, which is practically on a cash basis, takes place weekly on Tuesday. The principal settlement is on the first Tuesday of each month.

In the case of flax, the Dundee trade is in a few strong hands and the drafts against shipments from Russia are drawn, as a rule, upon the buyers direct, the connection of the banks being confined more or less to the retiring of the drafts when due.

FOREIGN TRADE.

Prior to 1861 exports of jute yarn and manufactures from the United Kingdom were lumped in the statistics with linen yarn and manufactures, while the reexports of foreign jute goods were first listed separately in 1897. The exports of British-made jute goods from the United Kingdom have been as follows:

Years.	Yarn.		Piece goods.		Other manufactures (except bags).
	Pounds.	Value.	Yards.	Value.	
1861	7,047,217	$414,266	6,519,252	$618,196	.....
1870	12,669,948	956,087	51,920,808	3,842,866	.....
1880	16,833,200	1,134,985	183,202,400	10,976,405	.....
1890	34,404,400	1,880,440	273,775,900	12,778,626	$201,497
1900	38,708,100	2,367,493	173,976,800	9,126,040	354,778
1905	46,201,900	2,923,657	170,383,800	9,624,648	456,319
1910	58,852,700	3,395,557	176,435,800	10,036,290	744,112
1911	49,326,100	3,426,722	149,415,700	9,951,214	1,053,471
1912	53,458,100	4,183,024	161,802,900	11,884,304	1,137,559

In quantity the export of jute yarn reached its maximum with 67,518,600 pounds in 1907, while the export of jute piece goods attained its zenith with 283,618,000 yards in 1891.

EXPORTS OF JUTE GOODS IN 1912.

In 1912 the exports of jute yarn and of jute piece goods were taken by the following countries:

Articles.	Quantity.	Value.	Articles.	Quantity.	Value.
YARN.			PIECE GOODS—continued.		
	Pounds.			*Yards.*	
Brazil	22,640,600	$1,934,443	Australia and New Zealand	5,995,600	$535,641
Portugal	6,926,100	553,438	Russia	3,691,700	183,652
Argentina	4,169,900	274,953	Germany	3,412,000	195,945
Canada	3,449,400	279,454	Sweden	2,969,200	150,132
Belgium	3,098,000	195,458	Venezuela	2,738,800	203,819
Netherlands	3,026,600	220,141	Chile	2,234,400	134,330
Germany	1,910,500	131,722	Turkey	2,046,900	140,442
United States	1,411,100	109,209	India	1,985,900	207,264
Spain	471,200	41,200	Denmark	1,895,400	170,264
All other countries	6,354,700	443,006	Netherlands	1,814,100	159,675
Total	53,458,100	4,183,024	Uruguay	1,690,700	147,619
			Peru	1,382,400	83,557
PIECE GOODS.			Ecuador	1,280,400	79,431
	Yards.		Cuba	1,122,800	74,506
United States	77,503,000	5,704,034	All other countries	8,710,700	789,368
Canada	22,930,700	1,600,285			
Argentina	12,208,300	1,054,259	Total	161,802,900	11,884,304
Norway	6,189,900	270,081			

PRINCIPAL MARKETS.

Of the export in 1912 of $1,137,559 worth of unenumerated manufactures of jute, the United States took $229,840, Australasia $133,104, and Argentina $133,960, with smaller amounts going to Cape of Good Hope, Denmark, India, Natal, etc.

About half the exports of British-made jute yarns go to Brazil, while about half the exports of British-made jute piece goods go to the United States. The maximum shipment to Brazil was 35,005,300 pounds in 1907, which year also marks the maximum reached for total exports of jute yarns. Brazil has long been the chief customer for British jute yarns, and though jute spinning in Brazil is now increasing, it has not yet succeeded in overtaking the increasing consumption of Brazilian looms. The imports of yarn by the United States fluctuate; according to the British figures they amounted to 2,882,000 pounds in 1906, 4,082,200 in 1907, 1,068,600 in 1908, 3,878,700 in 1909, 5,399,200 in 1910, 1,131,800 in 1911, and 1,411,100 in 1912. Dundee supplies the great bulk of the imported jute yarns used in the United States.

Dundee has always found its best customer for jute piece goods in the United States, though British India (which also finds its best market there) ships the United States five or six times as much. The United States took of British-made jute piece goods 86,473,000 yards in 1900, 121,673,700 in 1901, 97,720,700 in 1905, 83,746,300 in 1910, 66,893,900 in 1911, and 77,503,000 in 1912. Dundee piece goods imported by the United States average at least a fourth higher in price than Indian piece goods, which is due partly to the goods averaging finer and partly to the higher price obtained for Dundee products as compared with Indian goods of the same general make.

EXPORTS OF SACKS AND BAGS.

Statistics of the exports of empty bags and sacks from the United Kingdom do not specify the material, but they are now almost entirely of jute. The export of bags and sacks has been as follows: 46,346 dozen in 1840, 206,483 dozen in 1850, 623,752 dozen in 1860, 2,477,735 dozen in 1870, and 5,028,800 dozen in 1880, reaching a maximum of 5,471,683 dozen, valued at $7,320,535, in 1881. In 1890 the export was 2,677,605 dozen; in 1900, 2,334,400; in 1910, 3,698,252; in 1911, 5,012,664; and in 1912, 4,091,539 dozen. The exports in 1912 were taken by the following countries:

Countries.	Dozens.	Value.	Countries.	Dozens.	Value.
Argentina	891,074	$1,142,961	Turkey	122,827	$172,323
Germany	453,539	487,910	Chile	96,702	135,639
British South Africa	263,302	225,465	Sweden	95,810	106,902
United States	216,648	111,988	British West Africa	94,660	140,540
Canada	208,673	146,448	Guatemala	71,539	139,367
Netherlands	201,877	177,389	Colombia	66,947	166,717
Russia	181,041	225,626	All other countries	825,745	1,349,068
Belgium	163,267	146,852			
Denmark	137,888	156,215	Total	4,091,539	5,031,314

REEXPORT TRADE.

The imports and reexports of foreign jute yarn and of miscellaneous foreign manufactures of jute, including piece goods, bags, etc., according to British statistics, are shown in the table following.

Years.	Yarn imports.		Yarn reexports.		All manufactures except yarn.	
	Pounds.	Value.	Pounds.	Value.	Imports.	Reexports.
1900	6,337,659	$431,182	90,021	$5,874	$10,469,662	$9,141,440
1905	6,667,870	529,675	154,942	9,338	10,089,685	8,812,107
1910	3,442,185	263,886	420,784	20,994	12,559,381	8,524,784
1911	3,326,793	262,136	376,693	23,899	10,526,269	6,444,419
1912	4,742,342	394,483	288,095	18,882	11,530,242	7,016,442

The jute yarn imported is chiefly for consumption in the United Kingdom, while the imports of manufacture of jute of various kinds are mainly for reexport. Imports of jute yarn come principally from Belgium and France, while the reexports go mainly to Germany and Sweden. Most of the jute manufactures imported are supplied by British India, while over half of the reexports ($3,669,234 in 1912) go to the United States. In the same year Cuba took $606,862 of these reexports, while smaller amounts went to Argentina, India, Germany, Peru, Netherlands, Canada, etc. This import of foreign, mainly Indian, jute manufactures for reexport is due partly to convenience in reshipping and partly, in some cases at least, to an effort to obtain abroad for Indian goods the higher prices usually paid for the supposed better-quality Dundee goods. A considerable proportion of the jute manufactures exported from the United Kingdom, mainly from Dundee, is of Indian manufacture. For instance, of a total of $9,712,317 of jute yarn and manufactures shipped to the United States by the United Kingdom in the calendar year 1912, British-made yarn accounted for $109,209, British-made piece goods for $5,704,034, and British-made unenumerated articles for $229,840, while $3,669,234, or over 40 per cent of the total, consisted of manufactures of jute made in India or other countries.

In the foreign trade of the United Kingdom some manufactures of jute are included under the heading of "cordage, cables, ropes, and twine of hemp, coir, and like material," but as the great bulk of such goods is made of regular cordage materials, such as soft hemp and manila hemp, the proportion of jute is negligible.

JUTE FACTORIES.

According to Government reports, the number of spindles and looms in the jute factories of the United Kingdom and the number and kind of factories were as follows in the years stated:

	1870	1874	1878	1885	1890	1905
Spinning factories	10	26	26	30	25	25
Weaving factories	8	20	39	37	37	44
Spinning and weaving factories	42	63	50	51	51	38
Other factories	3	1	2	2	3	3
Total	63	110	117	120	116	110
Spinning spindles	109,000	220,911	212,676	253,179	268,165	263,938
Doubling spindles	6,156	9,274	7,492	11,024	11,874	14,203
Looms	4,330	9,599	11,288	12,083	14,107	13,704

The latest year in which spindles and looms were enumerated was 1905, and of the 278,141 spinning and doubling spindles then found 3,700 were listed as at work in England, 3,700 in Ireland, and 270,741 in Scotland. Similarly, of the 13,704 looms on jute in 1905, 470 were in England, 160 in Ireland, and 13,074 in Scotland.

DUNDEE THE CENTER OF THE INDUSTRY.

The jute industry of the United Kingdom is not only a monopoly of Scotland, but the great majority of the spindles and looms are within the corporate limits or suburbs of the city of Dundee. The manufacture of jute by machinery was inaugurated by Dundee, and as local conditions are favorable to its growth it has shown no tendency to spread to other parts of the United Kingdom.

Dundee, the capital of Forfarshire, is located on the north bank of the Tay, on the east coast of Scotland. Commercially it ranks second only to Glasgow among Scottish cities, though also exceeded in population by Edinburgh. It is noted chiefly for its jute industry, though there is a smaller manufacture of flax and hemp. Other industries include machine making, shipbuilding, and whaling, and the latter two are declining.

The population of Dundee, according to the census compilations, has been as follows:

Years.	Population.	Years.	Population.
1811	29,716	1871	118,977
1821	34,575	1881	140,794
1831	48,026	1891	155,675
1841	64,629	1901	161,173
1851	78,931	1911	165,004
1861	90,417		

Dundee owes most of its population to the jute industry. Between 1861 and 1881, when the jute industry was rapidly expanding and before it was affected by its great Indian competitor, the population increased by 50,000, or at the rate of 2,500 a year. In the 40 years prior to 1861 it did not increase by 900 per annum, while since 1881 the annual increase has averaged less than 700. At least a fourth of the entire population is engaged in the work of transforming raw jute into a finished product. The 1911 census showed 11,042 males and 23,368 females engaged in the manufacture of jute and hemp (the latter industry is small), in addition to those engaged in allied sections of the work, such as carpet and rug manufacture, dyeing, and finishing.

PRINCIPAL JUTE MANUFACTURERS.

According to the best information obtainable the following are the largest jute manufacturers in Dundee, those having over 5,000 spindles or 250 looms:

Firms.	Spindles.	Looms.
Cox Bros. (Ltd.)	20,000	1,000
J. & A. D. Grimond (Ltd.)	14,250	720
J. C. Duffus & Nephew	13,500	.....
James K. Caird	13,300	1,254
Gilroy, Sons & Co. (Ltd.)	12,000	800
Malcolm, Ogilvie & Co. (Ltd.)	11,000	1,000
Buist Spinning Co. (Ltd.)	8,500	.....
Boase Spinning Co. (Ltd.)	8,000	600
Victoria Spinning Co. (Ltd.)	6,000	.....
Henry Smith & Co	5,800	145
A. P. Mathewson & Co	5,000	.....
Thomas Bell & Sons (Ltd.)	3,000	350
James Smieton & Sons	.....	401
Wm. Fergusson & Sons (Ltd.)	.....	317
R. G. Kennedy & Co	.....	300
H. & A. Scott (Ltd.)	.....	300

The large firms of Baxter Bros. & Co. (Ltd.) and of Don Bros., Buist & Co., usually listed as flax firms, also work on jute, as was noted previously. The Aberdeen Jute Co. (Ltd.), at Aberdeen, has 2,568 spindles and 163 looms on jute, and some jute is also worked in small quantities at other points, mainly in connection with flax mills; but the total outside of Dundee is negligible. The floorcloth and linoleum industry centers at Kirkcaldy, which has three firms; there is also one each at Dundee, Falkland, and Newburgh, but these buy the wide hessians used as a foundation material and confine their work to making floorcloth and linoleum therefrom by covering with mixtures of linseed oil and various ingredients.

The 1905 figures showed for the United Kingdom 25 spinning, 44 weaving, 38 spinning and weaving, and 3 other kinds of jute factories, but the factories that spin their own yarns seem to comprise the bulk of the spindles and looms, and many of the spinning factories and especially the weaving factories are small concerns.

CAPITAL EMPLOYED—COST OF CONSTRUCTION.

In 1912 the agent of one of the largest Dundee banks stated: "It is difficult to form an estimate of the aggregate amount of capital invested in the local trade as represented by buildings, plant, machinery, general equipment, and raw and manufactured stocks, but it is believed that the capital so invested will amount to fully £10,000,000 ($48,665,000)."

Urquhart, Lindsay & Co. (Ltd.), who are among the largest makers of jute machinery, state that the cost of a complete spinning and weaving factory at Dundee, embracing buildings, plant, and equipment but excluding land, will average about £450 ($2,190) per loom in 1913, as against about £400 ($1,950) per loom in 1908. On this basis, figuring on 13,000 looms at £450, the plant investment would be, roughly, £5,850,000 ($28,469,000); and allowing for land and for working capital, the estimate of £10,000,000 above given may not be far from correct.

The great majority of the jute firms at Dundee are private concerns, those listed as limited being almost entirely private limited, so that little is published as to capital stock or profits; the preferred stock of Gilroy, Sons & Co. (Ltd.) is the only one regularly quoted on the local stock exchange.

MILL CONSTRUCTION AND EQUIPMENT.

The largest jute concern seems to be that of Cox Bros. (Ltd.), which is stated to have about 20,000 spindles and about 1,000 looms, and to employ some 5,000 operatives. The Dundee mills do not compare in size with those in India, and being older they are, as a rule, neither so well arranged nor equipped so completely with the most improved machinery. Most of the mills, especially those built in comparatively recent years, are on the one-floor, saw-tooth roof style, with round iron columns and concrete or stone flooring, though some of the largest are built with several floors. Most of the larger mills finish as well as spin and weave, but there are five well-equipped calender establishments that do nothing but finishing. Part of the bags are cut up and sewn in connection with the mills, part in separate establishments, while both give out some bags to be sewn at home. There are also separate dyeing, bleaching, and printing concerns, which work on both flax and jute goods.

The older mills are driven by geared shafting, the belt shafts being driven by large bevel gears working with those on the main shaft, but most of the mills are abandoning this system and use rope driving or else have adopted electric power. The electric motors are usually arranged for group driving, a motor for each separate line of shafting, but one or two firms have installed a small number of motors for individual driving. Electric power is supplied by the city, which installed a plant in 1893 and in 1900 took over the horse and steam tramways. In electrifying the latter it arranged for larger plants so as to have a surplus of power for sale to the public. The price for electric power, which at first was a flat rate of 2d. (4 cents) per unit of 1,000 watt hours, has been changed to a sliding scale, and mills are now charged 1½ d. (3 cents) per unit for quantities under 10,000 units and ¾d. (1½ cents) per unit for quantities over this amount in case a minimum is guaranteed. The use of electric power is increasing and some of the largest mills are now changing to this system, not only because of the greater convenience and steadiness of this drive but also because at Dundee most of the coal has to be hauled some distance and costs more than at almost any other large city in the United Kingdom.

COST OF MANUFACTURE.

Wages in the jute industry are comparatively low, but there have been several increases in the last few years. Manufacturers state that the higher wage scale, with the increase in general cost of production due to dearer supplies, etc., makes it increasingly difficult to compete with Calcutta, where labor is much cheaper and where, in spite of the Indian decrease last year from 15 to 13½ hours per day, the working hours are still much longer than those allowed in Dundee. They also object to the burden imposed by the national compulsory insurance act, and the president of the Dundee Chamber of Commerce at the closing meeting for 1912 stated that this item alone would cost the local factories £45,000 to £50,000 ($219,000 to $243,000), almost half of which would be contributed by the employers and the balance by the operatives.

PROCESSES OF MANUFACTURE.

The staple article of manufacture in jute mills is hessian (burlap), and the ordinary machines used are as follows:

Batching room.—Jute opener; softener.

Preparing room.—Breaker card; finisher card; first drawing frame; second drawing frame; roving frame.

Spinning room.—Spinning frame.

Yarn preparation.—Cop-winder machine (for weft); drum-winder machine (for warp); dressing machine; drawing-in (hand work).

Weave room.—Loom.

Finishing room.—Cropping machine; damping machine; calendering or mangling machine; inspecting and folding machine; baling press.

If any yarn is to be put up for sale, there is also a reel room, where the yarn is reeled into 90-inch hanks and then bundled for sale. However, in contrast to the system used in English cotton and worsted mills and in Irish flax mills, the great majority of the Dundee jute mills (by amount of machinery if not by number of mills) are self-contained, and carry out all processes from handling the raw jute to shipping the finished cloth.

BATCHING ROOM.

Jute is received at the mill in bales of a uniform weight of 400 pounds, the bales being bound with roughly twisted jute ropes and having no covering. The bales are packed under an hydraulic pressure of about 4 tons to the square inch to make each measure uniformly 10 cubic feet, and as this pressure mats the stricks together, it is necessary to run the jute through a bale breaker to disentangle the stricks before they can be handled for working. This bale breaker, usually called a jute opener, consists of three or more heavy rollers with blunt teeth working into the grooves of each other, and its action softens as well as opens up the jute layers. Usually six bales of jute are grouped around the jute opener, the jute ropes are then cut with an axe and alternate layers from the various bales are laid on the feed plate and run through the machine.

The batchers take the opened-out material as delivered and piece out the long fiber in handfuls weighing about 2 pounds each, which they lay on a low platform ready for the softener. They also roughly sort it by laying aside any stricks that appear too dark, rotty, or inferior in any way to the general run of the batch being worked. This inferior material is later run through in a batch by itself.

The handfuls of fiber prepared by the batchers are next run through the jute opener, which is a long, narrow machine consisting of many pairs of straight and spiral rollers. In its passage through the machine it is not only subjected to the softening action of the rollers, but first water and then oil are automatically fed on it to make it softer and more pliable. The water and oil are usually kept warm. The amount of water used varies in different mills, being determined by the ideas of the management, the different kinds of goods to be made, and also the temperature and state of the atmosphere. Frequently it is 15 to 20 per cent, but most of it dries out in the subsequent preparing and spinning processes. The oil is usually mineral

oil, sometimes mixed with whale or seal oil; the animal oils alone are too expensive for any but the finer grades of material. The amount of oil varies from 1 to 2 gallons per 400-pound bale of jute, but the amount and proportions of both oil and water are varied according to circumstances and the individual ideas of the managers.

The stricks of softened jute are stacked up on a barrow or wagon and allowed to stand some 24 hours, so that the oil may become uniformly distributed throughout the mass before working.

Formerly the material was run through the softener rollers dry and was then stacked, watered, and oiled with a can in successive layers in a large barrow, and left 24 to 48 hours before use; but machine batching has now almost entirely superseded hand batching, though the latter is still used in a few mills on finer work.

PREPARING ROOM.

So far the jute has been handled in the long pieces, or stricks, in which it was shipped. It is impossible, of course, to run fibers 5 feet or more in length into weaving yarns, so on entering the first card the material is cut, or broken, into lengths more convenient for working, usually about 10 inches, and for this reason the first card is called the breaker.

At the back of the breaker is a sloping feed sheet. The operative weighs a fixed amount of material, which is called a dollop, and spreads the long stricks on the feed sheet so that the dollop will be drawn into the card in a single round of the clock attached to the feed roller above. Uniform feeding is necessary in order that the resultant sliver from which is made the roving and yarn may have a uniform weight per yard. The weight of the dollop of long slivers laid by hand on the feed sheet during each revolution of the clock is calculated so that, with certain doublings and drafts on the successive machines, each spyndle of 14,400 yards of yarn produced on the spinning may have the desired weight.

The cylinder of a jute card, whether breaker or finisher, is usually made 6 feet wide and 4 feet in diameter, and though there is no uniform speed, it is customary to run the breaker at about 190 and the finisher at about 180 revolutions per minute.

BREAKER CARDS.

Breaker cards usually have two workers and two strippers, the first with effective diameters of $8\frac{1}{2}$ inches and the latter of $10\frac{1}{2}$ inches, with tin cylinders underneath. There is one feed roller and shell, a 15-inch doffer, and calendar rolls. The long fiber, as it is drawn in between the feed roller and the shell, is broken up over the edge of the latter by the downward blows of the cylinder pins, and the cylinder draws the resultant short tow lengths around with it underneath, where it is combed, cleaned, and paralleled by the combined action of the teeth of the card and the two workers, the latter being kept clean by the strippers. The fleece is taken off the card in front by the doffer, which in turn is stripped by the action of a pair of metal rollers extending across its face; the resultant web is drawn down an inclined condensing conductor to the calendar rollers, which compress it into a sliver that drops of its own weight into a stationary can in front, and these cans are taken to the finisher card.

FINISHER CARDS.

Some finisher cards are made up-striking and some are half-circular, so that the sliver is taken in at the back and delivered at the front; but the most usual type of finisher card is the full-circular down-striking. In the full-circular finisher card the cans of sliver, usually 8 or 10 in number, are fed in underneath the delivery plate at the front and the material is drawn around the card, being combed, cleaned, and paralleled as before by the action of the teeth of the card and workers. The doffers, of which there may be one or two, are stripped by vibrating knives and the fleece is usually drawn off in three sections through trumpet-mouthed conductors. These three slivers are drawn around large guide pins, and, if two doffers are used, unite with three similar slivers produced by the lower doffer. Most breaker cards have only two pairs of workers and strippers, but full-circular finisher cards usually have four or five pairs.

The draft on jute cards is short, seldom exceeding 20 and not often below 12, an average for finisher cards being about 15. The usual production of a breaker card is about 7,000 pounds per day of 10 hours, and two finishers are fed by each breaker. The production depends, of course, on the speed considered best for the work in hand and on the weight per yard of the sliver desired.

DRAWING FRAMES.

In the ordinary hessian system there is a first drawing, doubling four into one, and a second drawing, doubling two into one. With the usual weights and drafts, $3\frac{1}{2}$ draft for the first drawing and 8 draft for the second drawing, one finisher card will supply a two-headed first drawing. This supplies a two-headed second drawing, which in turn delivers sufficient material to keep in operation a 56-spindle roving frame with 10 by 5 inch bobbins. Usually the breakers, the finishers, the first drawing frames, and the second drawing frames are arranged in parallel lines and the roving frames are placed at right angles to same. Jute sliver cans are always stationary, not revolving as in the cotton trade, and they are usually oval in shape, though some are oblong and some rectangular. Ordinary dimensions are 13 by 11 inches for breaker cans, 12 by 9 inches for finisher cans, 12 by 9 inches for first-drawing cans, and 10 by 7 inches for second-drawing cans; they are usually 36 inches in height.

The cans from the finisher card are put up at the back of the first drawing and each end, or two ends working as one, are drawn in separately through the feed rollers. The rows of steel-pins carried by successive short gill bars strike up into the sliver and carry it forward to the drawing rollers. The sliver is combed and drawn out in the process by reason of the gill bars having a speed slightly greater than the surface speed of the feed rollers and the drawing rollers having a surface speed considerably greater than that of the gill bars, so that, as the fibers are drawn past each other while supported by the gill pins, the sliver is cleaned and paralleled as well as attenuated. The gilling arrangement in the preparatory processes of jute spinning is similar to that used for other long fibers, such as flax and wool, but with reach, speeds, size, and spacing of pins

suitable for the coarser grade of material worked. From the drawing rollers one end goes straight and the other three are turned at right angles through slits in the front plate, so that the four ends may be doubled into one and fall into the stationary can beneath.

The cans from the first drawing are put up at the back of the second, or finisher, drawing, each end passing separately through feed rollers, gills, and drawing rollers. Each two ends are then doubled into one at the front to fall into the can beneath, these cans then going to the roving frame. In both first and second drawing there are usually two heads, or deliveries, per frame.

The drawing frames are designated according to the system used for driving the gill bars (which carry the slivers from the feed to the drawing rollers) and then bringing the bars back underneath to strike up again into the slivers and repeat the operation. With the better grades of flax there is ordinarily used the screw gill arrangement (described in the chapter on Irish flax), as this makes the most perfect work. However, such perfection is not necessary for jute and the speed permissible is too low to make it economical. Sometimes there is used a circular, chain, or other system of driving, but as a rule the first drawing at Dundee is on the push-bar type, which has been very successful and which permits high speed, 350 drops of the gill bar per minute being most customary. The gill bars rise up straight at the back and are actuated by four pinions, one on each side above and below.

The term "push," or "slide," drawing is derived from the fact that the bars directly in the teeth of the pinions push forward those that are disengaged until the latter are again brought into contact with the pinions. The second, or finisher, drawing is usually a spiral drawing, so called from the gill bars being actuated by screws. This type can not be driven so fast as the push-bar type, which for some work is also used for second drawing. There are usually only about 160 drops of the gill bars per minute in spiral drawing, but it makes better work.

ROVING FRAME.

The drafting arrangement of the roving frame is practically the same as in the drawing frames, and the gill bars are usually actuated by screws on the spiral system. There is no doubling; the cans from the finisher drawing are put up at the back of the roving frame and each sliver is run through separately, going through feed rollers, gills, and drawing rollers, and then being wound on large doubled-headed bobbins by means of a flyer; a slight twist is inserted in the operation. In jute as in flax roving frames, the flyer has a constant speed and leads the bobbin; as the diameter of the bobbin increases, its speed must increase correspondingly, and this is accomplished by the use of various differential driving systems. Speeds of roving frames are now considerably higher than formerly, a fair average for frames with 10 by 5 inch bobbins being about 675 revolutions of the spindle per minute, while the tendency is toward still higher speeds. The draft on roving frames varies between 6 and 10, a draft of 8 to 9 being most general.

SPINNING ROOM.

The double-headed bobbins of rove are carted to the spinning room and stuck on the almost horizontal pins in the creel of the spinning

frame. Each end of roving is drawn down between a pair of feed, or retaining, rollers and thence over a rove plate or breast beam and through a tin roving conductor to a pair of drawing rollers, which are below and slightly forward of the feed rollers; thence it passes through the thread plate eye and is wound on to small double-headed bobbins by means of a flyer, a calculated amount of twist being inserted in the operation. The rove is drafted and attenuated between the retaining and the drafting rollers; the front roller in both cases is of steel and the back roller is pressed against it by means of a lever and weight. The retaining roller is usually 2½ inches and the drawing roller 4 inches in diameter. The top pressing roller is of steel and fluted to correspond with the retaining roller, while the bottom pressing roller is of wood, usually sycamore, and turned to a narrow face, which is embraced by the wings of the tin conductor that hangs loose upon a bar.

The reach, or distance from center to center, of the retaining and drawing rollers is usually about 10 inches. The spindles are usually driven by tapes 1¾ to 2¼ inches in width. The speed of the spindles varies from about 2,500 revolutions per minute for 18 to 24 pound weft made on a frame with 5-inch gauge (distance between spindles) up to about 3,300 revolutions per minute for 8-pound warp made on a frame with 3¾-inch gauge. With improvements in the manufacture of spinning frames the speeds have shown a tendency to increase. The distance between spindles, called gauge or pitch, is usually 3½ to 3¾ inches for 5 to 7 pound yarn, 4 inches for 8 to 12 pound yarn, 4¼ to 4½ inches for 12 to 20 pound yarn, and 5 inches for 20 to 40 pound yarn.

In the spinning of hessian warps and wefts three sizes of bobbins are customary—the 3¾-inch bobbin (this refers to the traverse, or height, between heads) for 7 to 8 pound warp, the 4-inch for 9 to 16 pound yarn, and the 5-inch for 16 to 24 pound yarn. The over-all length of the spinning frames is usually about 27 feet, giving from 114 to 154 bobbins for the double frame.

Frames with 60 or 72 spindles to the side seem to be most common, and ordinarily one spinner runs two sides, some running only one side. Usual spinning drafts are 7 or 8. A fair average production is given as 4 spyndles (of 14,400 yards each) per spindle per 55-hour week on 7-pound hessian warp. The amount of twist or turns per inch given varies according to the quality of the jute and the purpose for which the yarns are made, as well as according to the yarn count. Warps to be used double are twisted a little less than those to be used single; spinners' twist yarns going direct to their own looms are twisted a little less than yarns intended for sale, etc. The standard 3-pound warp usually has 8 to 8½ turns twist per inch and 3-pound weft 5½ to 6½ turns twist per inch. The twist required for any other number is frequently based on these and is obtained by multiplying the turns twist for 3-pound yarn by the square root of 3 and dividing by the square root of the number to be twisted.

The bobbins have a groove in the base, and a drag cord, which is fastened to the ring rail at the back and hangs down in front with a small weight attached, is laid in a notch in the front part of the rail. This cord is moved up as the bobbin fills, so as to put more friction or drag on the base until the frame is full, when the drag cords are all started back at the first notch, where the cords just

touch the bobbin. Jute machinery has never attained the automatic perfection of cotton-mill machinery, and in this, as in other jute machines, there is clearly much room for improvement by the use of labor-saving appliances. There is now on the market an automatic drag-cord shifting arrangement, by means of which a notched rail in front carrying the drag bands is automatically moved up and increases the tension on all bobbins uniformly as they fill up, but manufacturers have not yet adopted it to any extent, and the spinner still shifts the drag cords one by one. Recently there has been brought out an electric stop motion, called Sharp's patent rove stop, which prevents waste by automatically shifting the roving out of the retaining pair of rollers when an end breaks, but as 10s. 9d. ($2.62) per spindle is charged for its attachment, it is too costly for general use. Patent ball-bearing spindles, patent tension cylinder drive, etc., are other improvements now being tried tentatively. Some jute spinning frames have also been installed on the ring-spinning system, but the flyer-spinning system is in general use. (Fig.8.)

YARN NUMBERING SYSTEM.

The number, or count, of jute yarn is stated in terms of the weight in pounds of an arbitrary length of 14,400 yards, which is called a spyndle, or sometimes a spangle. Three-pound yarn therefore means that a spyndle of 14,400 yards weighs 3 pounds; 8-pound yarn means that a spyndle of 14,400 yards weighs 8 pounds, etc. The higher the yarn number, therefore, the coarser the yarn, which is the reverse of yarn numbering systems like those for cotton, fine linen (lea system), worsted, etc., which are based on the pound instead of an arbitrary length. In the full yarn numbering table, 90 inches, the circumference of the reel, makes a thread; 120 threads, or 300 yards, make a cut, or lea; 2 cuts, or 600 yards, make a heer; 6 heers, or 3,600 yards, make a hank; and 4 hanks, or 14,400 yards, make a spyndle.

Jute yarns and dry-spun flax yarns are numbered on the same system, so the table of equivalent yarn counts given on page 87 applies to jute yarns.

YARN PREPARATION.

Most of the Dundee looms are supplied with yarns spun in the same establishment, but although all the work may be carried on under the same roof the operations up to and including the finished yarn are considered to belong to the mill, while subsequent operations are carried on in what is referred to as the factory.

WINDING FRAMES.

In the factory the first machines are the winding frames. Weft yarns are wound into cops on the bare spindles of weft-winding machines of various types. Where yarns are bought from outside or have been bleached or dyed they wind from the hank, but most of them are made for winding from the spinning bobbin. The great bulk of the jute weft yarn is now wound into cops instead of onto pirns, and as there is less drag in the shuttle as the yarn pulls

out from the inside of the cop instead of over the nose of the pirn, jute selvages are now not uncommon for sacking and bagging. Formerly all jute goods had to be woven with cotton selvages, as is still the case with hessians and other medium-fine goods. Owing to the hard and slippery nature of the material, jute cops have to be

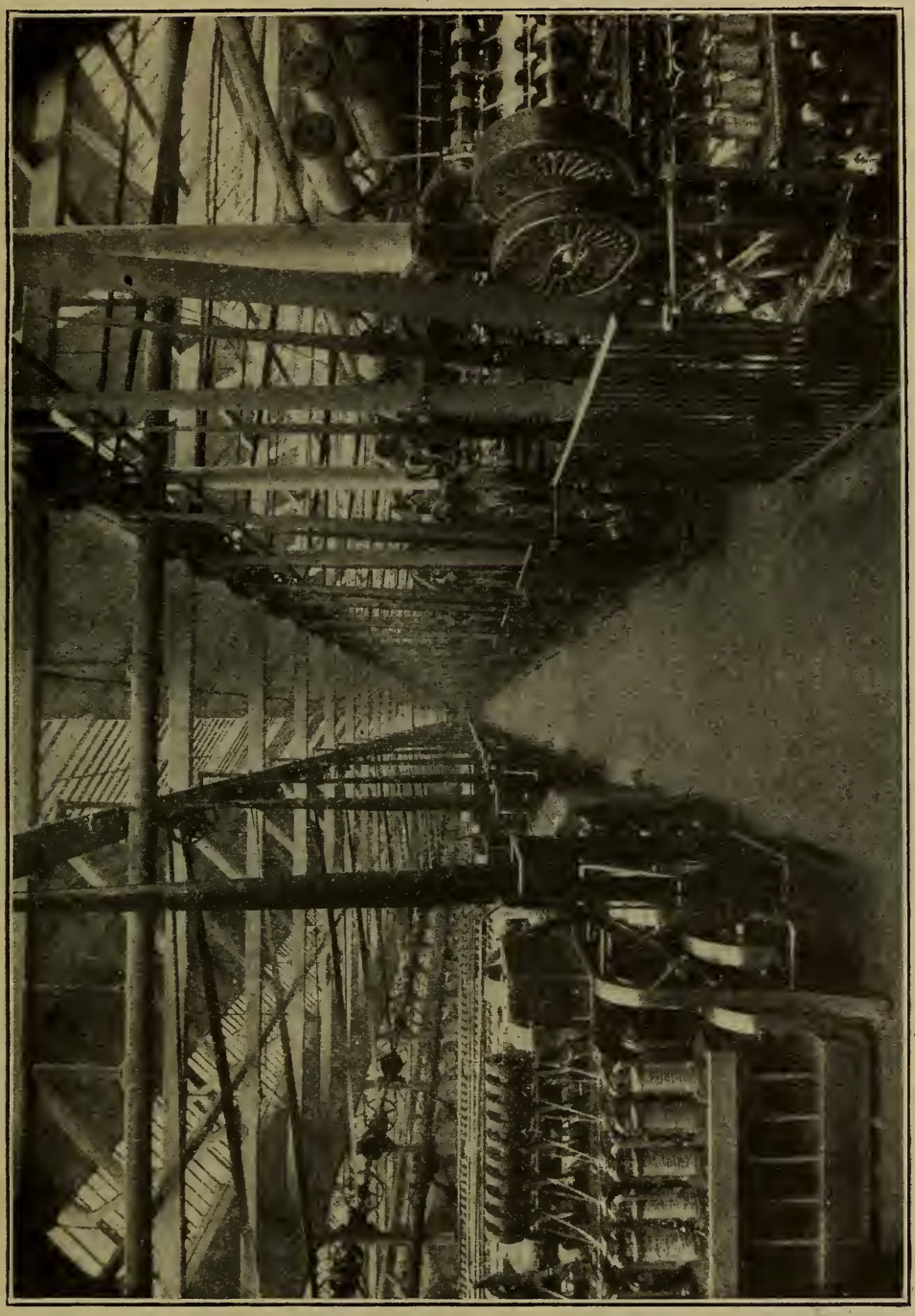

FIG. 8.—Jute roving and spinning frames.

built up under considerably more tension than is necessary for cotton cops. The size of the cop varies according to the size of the shuttle suitable for the kind of yarn being spun, but ordinary jute cops are 8 to 10 inches long and $1\frac{1}{4}$ to $1\frac{3}{4}$ inches in diameter.

Jute warps are usually wound from the spinning-frame bobbins into cheeses, or rolls, there usually being a double line of drums to

each machine. These cheeses are taken direct to the slashing room and placed in the creels of the slashing machine, which is usually called a dressing machine. A cheese of 8-pound yarn may hold 14,400 yards, and will therefore weigh 8 pounds.

DRESSING AND DRAWING IN.

Dressing machines for jute are made double, that is, there is at each end of the machine a V-shaped creel carrying half the number of ends desired in the warp. These machines are of various types and may have 4, 6, or 8 cylinders, but the 6-cylinder type is most common. The sheet of ends as drawn from the creel at one end of the machine passes through a coarse reed, then through a size box and around three large drying cylinders full of steam. It is then wound up evenly, together with a similar sheet of ends from the other side, on a weavers' beam placed in the center. In the jute trade, loading

FIG. 9.—Shuttle used in jute weaving and weaver's reed hook, etc.

agents are seldom employed, and the weight added to the warp varies from 5 to not over 25 per cent. Various materials and proportions are used in sizing, but the mixtures are generally restricted to common adhesive substances such as farina and wheaten flour, with the addition of some softening material, such as tallow or oil, and zinc chloride as an antiseptic.

The loom beams from the dressing machine, after the ends are drawn in by hand through reed and heddles, are taken to the looms. Neither knot-tyers nor automatic drawing-in machines have yet been found that can be adapted to such brittle and inelastic materials as jute and flax.

WEAVING ROOM.

Most jute cloths are woven either plain or with simple twills. Weavers usually operate two looms only, a few running three, while on wide goods there is a weaver to each loom. The cone overpick is

most widely employed for jute; a few underpick looms are seen but no automatic looms. As the inelastic nature of the jute fiber does not give the warp threads the same tendency to shrink, when relieved from the distending power of the reed, as do elastic fibers like cotton and wool, and as the fabrics generally woven are comparatively coarse, temples are unnecessary and their use is practically unknown in jute weaving. Owing to the comparatively low speeds at which jute looms are driven, shuttle guards also are usually considered unnecessary. Jute shuttles for ordinary hessian cloths are usually about 20 inches long by about 2 inches square; generally they weigh about 2 pounds, but vary from 12 ounces up to 3 pounds. Shuttles used in the cotton trade have a cone-tipped end that fits into a depression made in the leather picker, but jute shuttles are usually made with

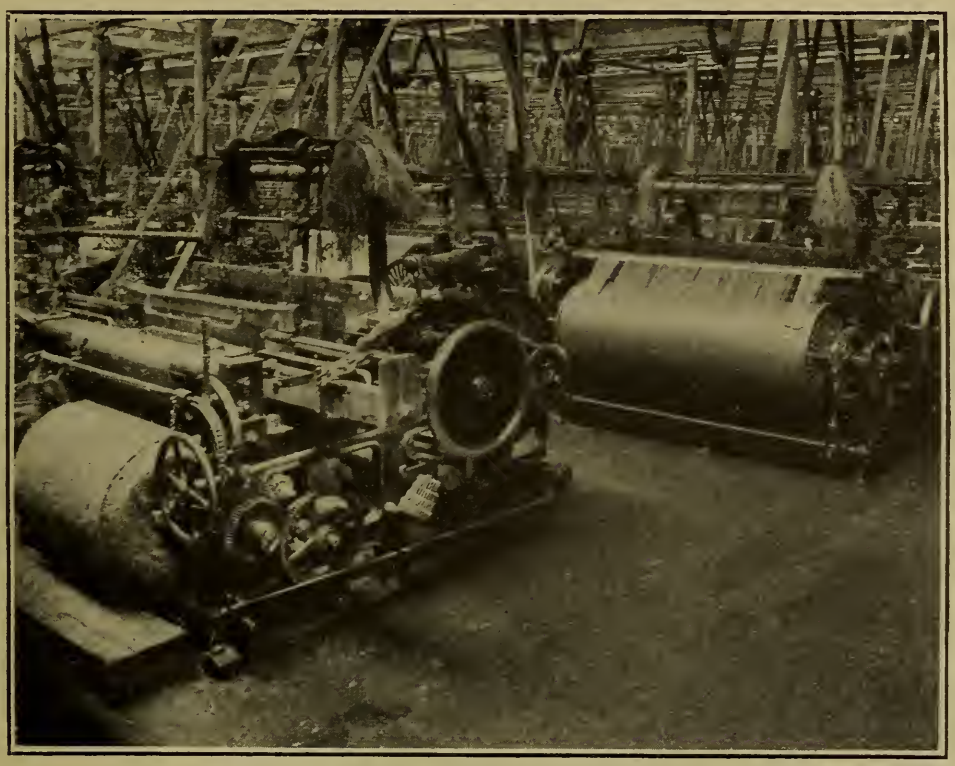

FIG. 10.—Jute weave shed.

a flat or side tip. The pointed tip occupying about a third of the width at the end is only for guidance, while most of the end is flat and this part is struck by the picker. (Fig. 9.) Among advantages claimed for this system is that it makes for less rapid wear on the picker employed. Some jute cloths, such as those for paddings, bags, and other goods to be cut up for special purposes, are made in narrow widths and are woven two or more at a time in the same looms by using some form of center-selvage attachment. The widest loom used in the jute trade is the 8 yard. Extremely few are so wide as this, though there are several that weave goods 4 yards wide to be used as the foundation of wide linoleums. The standard loom for weaving 40-inch hessians is made with a 46½-inch reed space. (Fig. 10.)

The ordinary speeds at which hessian looms are operated at Dundee is given by Urquhart, Lindsay & Co. (Ltd.), as follows:

Reed space.	Picks per minute.
Inches.	
32½	160
37	155
46½	150
52	145
56	140
68	125
80	110
90	100
110	85

At one of the largest jute mills at Dundee I found a loom with 160-inch reed space, making 144-inch cloth and operated at 80 picks per minute; but the majority of the looms in this mill on 40-inch hessian were making only 135 to 140 picks per minute.

FINISHING ROOM.

After weaving the cloth is run through a cropping machine to clip off all thread ends, and then through a damping machine to moisten it slightly for the subsequent process. It is then taken to the calendering machine, where it is run through heavy rollers. The moistened threads are mashed down flat, and this fills up the cloth and gives it a smooth appearance. If a more finished glazed appearance is desired, it is run through a mangling machine. These machines are so heavy that many have a separate engine or motor for driving. The cloth is wound on a steel roller, which is swung in between two large rollers that are revolved alternately backward and forward. The friction set up by the heavy pressure employed heats the cloth and flattens the threads so that a glazed finish is given to both sides of the cloth from the outer to the innermost layer. Three swinging rollers are used to keep the machine in continuous operation, one roll being wound on and another off while the third is being operated on. These machines are made wide enough to take one, two, or more pieces side by side, and usually 10 minutes is allowed for finishing a roll 100 to 112 yards long. The product is known as mangled hessians.

After calendering or mangling the finished cloth is measured, folded, and baled for shipment.

JUTE-MACHINERY MAKERS.

The preparing and spinning machinery required in jute mills of the United Kingdom is made principally at Leeds, smaller quantities being manufactured in Monifieth and Belfast. Nearly all weaving and finishing machinery, as well as machinery for opening and softening jute, is made in Dundee.

The largest machine makers at Dundee are Urquhart, Lindsay & Co. (Ltd.), who started business in 1863 and became a limited-liability

company in 1897. They make a specialty of jute-finishing machinery, such as calenders and mangles, and are also large producers of winding and weaving machinery and of jute openers and softeners. Their machinery is found all over the world and is largely used in India. In addition to jute machinery they make triple-expansion engines, large rope pulleys, cut gears, etc. In normal times they employ 700 to 800 workers.

James F. Low & Co. (Ltd.), located at Monifieth, near Dundee, started in 1811, though not floated into a private-limited company until 1902. They manufacture preparing and spinning machinery and when running full employ about 500 workers. They hold the British rights of manufacture of the Prause patent mechanical-doffing spinning frame, but on application refused to give out either prices or catalogue cuts of their machinery.

Robertson & Orchar (Ltd.), of Dundee, make looms, softeners, winders, and finishing machinery. They make a specialty of sewing machines for the jute trade and also manufacture machinery required in the linoleum trade.

Charles Parker, Sons & Co., of Dundee, make preparing, weaving, and finishing machinery. The Victoria loom made by them for the weaving of heavy navy canvas is claimed to be the only loom on this market capable of making mathematically correct cloth.

D. J. Macdonald, of Dundee, makes bag-making machines, yarn testers, waterproofing and other machinery for the treatment of cloth.

The largest concerns making jute-preparing, jute-roving, and jute-spinning machinery are Fairbairn, Macpherson & Co. and Lawson & Co., both of which are located at Leeds and now form branches of the one firm of Fairbairn, Lawson, Combe, Barbour (Ltd.). The Combe-Barbour branch of this firm is located at Belfast and manufactures machinery for jute as well as for flax and hard fibers. The Shettleston Iron Works at Glasgow also make preparing and spinning machinery for jute mills.

The period of prosperity for the jute trade that started about the middle of 1911 and is still in full swing has been reflected in a corresponding boom in jute machinery. Machine makers had a busy time in 1912, as orders for all classes of machinery were plentiful. Very large orders have been and are being placed for new mills and extensions in Calcutta, as well as for extensions and replacements in Dundee and district, while the Continent has continued to increase its number of wide looms. The makers of both flax and jute machinery have seldom been busier, and they have a full year's work ahead of them. New Indian mills can not now get machinery guaranteed before 1914.

DUNDEE PUBLIC CALENDERS.

The larger of the Dundee jute mills finish goods in their own factories, but there are also five public calenders that calender, mangle, stiffen, and otherwise finish goods woven in the local mills, as well as dyeing, cutting up and making into bags, stamping, baling, and shipping if desired.

These calenders from time to time issue minimum price lists giving the uniform rates charged for various work on the woven cloth. The uniform lists, effective April 1, 1913, are as follows.

TARIFF OF MINIMUM CHARGES OF THE DUNDEE PUBLIC CALENDERS, VIZ, TRADES LANE CALENDER, DUNDEE CALENDER, LADYWELL CALENDER, COWGATE CALENDER, FORBES & CHRISTIE, APRIL 1, 1913.

CROPPING.

Cloth 20 inches wide and under, $\frac{1}{36}$d. per running yard; above 20 inches wide, $\frac{1}{21}$d. per square yard. Goods above 14 ounces and not above 16 ounces per square yard, $\frac{1}{16}$d. per square yard. All hemp goods and all goods above 16 ounces per square yard, $\frac{1}{12}$d. per square yard.

FINISHING, ETC.

Calendering, or chesting, including measuring and making up, goods under 18 inches, $\frac{1}{16}$d. per running yard; from 18 to 24 inches, $\frac{1}{8}$d. per square yard; from 24 to 40 inches, $\frac{1}{12}$d. per running yard; above 40 inches, in proportion to 40-inch rate.

Hessians, if split, $\frac{1}{9}$d. per square yard for calendering, splitting, and extra making up. Paddings, if split, $\frac{1}{10}$d. per split yard for calendering, splitting, and making up.

Goods over 84 inches and up to 100 inches wide, calendered and made up, $\frac{1}{9}$d. per square yard; over 100 inches wide, by arrangement. Goods over 45 inches and up to 84 inches wide, over 20 ounces per square yard, calendered and made up, $\frac{1}{9}$d. per square yard; over 84 inches wide, by arrangement. Double finish, rate and third.

Goods rolled on boxes, $\frac{1}{48}$d. per square yard additional, which will include the charge for stitching; boxes to be supplied by customers. Goods 52 inches wide, or over, rolled full width, $\frac{1}{48}$d. per square yard extra.

American burlaps up to 40 inches wide, uncrisped, whether pieces or cuts, $\frac{1}{12}$d. per yard, less 12½ per cent discount for chesting, making up, and ordinary packing with 2 hoops and sheet; up to 49 inches, in proportion. Burlaps, 40 inches wide weighing over 12 ounces, not subject to discount. If bales weigh over 16 hundredweight, an extra hoop may be put on free. If double finished, rate and quarter. These special rates to apply only where bales contain 2,000 yards or over.

Calendering only, 40 inches and under, $\frac{1}{18}$d. per running yard; above 40 inches, in proportion to 40-inch rate. When measured, ½d. per cut. Splitting goods, 1d. per split cut, and when measured, ½d. per split cut.

Calendering, measuring, cutting up, and bundling for bags, $\frac{1}{12}$d. per yard up to 40 inches wide; above 40 inches, in proportion.

Cutting up and bundling for bags, $\frac{1}{24}$d. per yard up to 36 inches; above 36 inches, $\frac{1}{24}$d. per square yard. If tied, 1d. per bundle of 50 bits, or 1½d. per bundle of 100; the charge for tying applies to goods forwarded loose or goods packed. Uncrisping goods, 2d. per cut.

Calendering only, goods over 84 and up to 100 inches wide, $\frac{1}{12}$d. per square yard; over 100 inches wide, by arrangement. Calendering only, goods over 45 and up to 84 inches wide, over 20 ounces per square yard, $\frac{1}{12}$d. per square yard; over 84 inches wide, by arrangement. Double finish, rate and third.

REAL SELVAGE JUTE HESSIAN IN NARROW STRIPS.

Chesting, up to 40 inches, $\frac{1}{18}$d. per yard; over 40 inches, in proportion. Measuring, ½d. per full-width cut. These charges are omitted when goods are received finished.

Splitting, 1d. per cut. Rolling, up to and including 7 yards per end, $\frac{1}{12}$d. per split yard; over 7 and up to 15 yards, $\frac{1}{18}$d.; over 15 and up to 30 yards, $\frac{1}{24}$d.; over 30 yards, $\frac{1}{36}$d. Twine, $\frac{1}{8}$d. per end. Heavy goods by special arrangement. If P. S., rate and third.

Dice damasks, etc., calendering and making up, $\frac{1}{10}$d.; over 36 inches, $\frac{1}{10}$d. per square yard. Cloths, damasks, etc., calendering and making up, $\frac{1}{6}$d.; over 36 inches, $\frac{1}{6}$d. per square yard. Towels, calendering, cutting up, and counting,

⅛d. per yard: if rough, cutting and counting, ⅛d. per yard; folding, pressing, and tying, including twine or tape, 2d. per dozen, whatever the size of the bundle: if rebundled, to be charged twice. Double finish, rate and third. Extra finishes to be charged extra rates.

Glazing, goods under 20 inches, ⅛d. per running yard; from 20 to 30 inches, ⅛d. per running yard; from 30 to 40 inches, ⅛d. per running yard; above 40 inches, in proportion to 40-inch rate.

Single mangling, making up, and ordinary packing in twilled sheet and 2 hoops, American burlaps up to 40 inches wide, ⅛d. per yard net, and up to 49 inches in proportion. Bales to contain not less than 2,000 yards. If bales weigh over 16 hundredweight an extra hoop may be put on free. If double mangled, $\frac{5}{32}$d.

Mangling, including making up: Jute goods, single mangling, ⅛d. per running yard up to 36 inches wide; above 36 inches wide, ⅛d. per square yard. Jute goods, double mangling, ⅛d. per running yard up to 36 inches wide; above 36 inches wide, ⅛d. per square yard. Patent selvage jute hessians, single mangling, splitting, and making up, ⅛d. per square yard; double mangling, splitting, and making up, ¼d. per square yard. Hessians or other jute goods over 16 porter to be charged as linens. Other goods under 18 inches wide, ⅛d. per running yard; 18 to 24 inches, $\frac{3}{160}$d. per square yard; 24 and under 26 inches, ⅛d. per running yard; 26 to 36 inches, ¼d. per running yard; above 36 inches, ¼d. per square yard. On goods received calendered, no allowance can be made.

Goods sent out unmade-up, one-sixth less. Goods returned in mill fold, 1d. per piece or cut. If crisped, 1½d. per cut; if measured, ½d. per cut.

Dices, damasks, etc., mangled and made up, ¼d. per running yard up to 36 inches; above 36 inches, ¼d. per square yard.

All union dices, damasks, etc., and all linen dices, etc., under 22 porter, $\frac{1}{24}$d. per square yard extra to above rates.

Cloths, mangled and made up, $\frac{3}{160}$d.; if over 36 inches, $\frac{3}{160}$d. per square yard.

Stitching, Tying, Etc.

	Full width.		Crisped.	
	Stitching.	Tying.	Stitching.	Tying.
Rolled goods:	*Pence.*	*Pence.*	*Pence.*	*Pence.*
Up to 55 yards	½	¾	¾	1
From 55 to 105 yards	1	1¼	¾	1½
From 105 to 210 yards	¾	1¾	1	2
Over 210 yards	(1)	(1)	(1)	(1)
Lapped goods:				
Under 55 yards	½	1	1	1¼
From 55 to 150 yards	¾	1¼	1½	2¼
From 150 to 210 yards	1¼	1¾	2	3
Over 210 yards	(1)	(1)	(1)	(1)

[1] Extra in proportion.

All goods 52 inches and up to 60 inches wide to be charged rate and quarter; above 60 inches, rate and half. Goods made up book fold or if with cross twine, rate and half. Creas, etc., under 65 yards, stitched with twine and silk, 4d. per cut; over 65 yards, 6d. Twice-crisped goods to be charged double for twine. Jute bagging, etc., twice crisped to be charged net, both for finishing and twine. Pressing, ¼d. per cut. Two fancy slips, ¼d. extra per cut; if over 30 yards, ½d.

Papering and Outside Tying, Stamping, Etc.

Cloth, 36 inches wide and under, 1½d. per piece up to 50 yards; 2½d. per piece up to 80 yards; above 80 yards, 3d. per piece. Cloth over 36 inches wide, one-half more. When ends are not covered, or when crisped, a third less. Inside lining to be charged extra.

Tying and papering dices and damasks, 50 yards and under, single paper, 3½d.; over 50 yards, 4½d. Double paper, 4½d. and 5½d., respectively.

Crisping, folding, pressing, papering, and tying cloths, half-dozen packages, 3½d.; dozen packages, 5d.

Ticketing or stamping length or number on goods received for packing or forwarding only, ¼d. per cut or piece, net; other ticketing or stamping ½d. per cut up to 72 pounds weight and ¾d. per piece or cut over 72 pounds, net. Stamping goods finished in calender if in more than one color, ¼d. for each color (but where width, length, or number only is in a different color, no charge to be made); if received finished, ½d. for first color and ¼d. for each color additional, whether block stamping or otherwise.

Papering and tying twine, 2d. per 12-pound bundle; yarn, 2½d. per short bundle, net.

Ticketing only, yarn or sacks, 1d. per 10 bundles. Tickets, if furnished or written, 2d. per 10 bundles, net.

Rough Goods and Goods Received Finished.

Making up, exclusive of twine, 36 inches wide and under, $\frac{1}{24}$d.; over 36 inches, $\frac{1}{24}$d. per square yard; if crisped, $\frac{1}{20}$d. in each case.

Measuring only, or testing lengths, cut or half piece, 1d.; whole piece, 1½d. Turning and tying, or taking out samples, 2d. per cut or 3d. per piece; but two pieces of each parcel for inspection may be done free. If split, 2d. per split cut additional.

Goods, 52 inches wide, or over, rolled full width, $\frac{1}{48}$d. per square yard extra.

Weighing—Net.

Weighing or testing weights, separate bundles or pieces, ⅛d. per bundle or piece; if over 56 pounds, ¼d.; over 84 pounds, ½d.; over 1 hundredweight, 1d.; over 1½ hundredweight, 1½d. Two of each lot free.

Weighing in lots, 1s. per ton.

Weighing bales and finished pieces in lots for carriage or freight, if by steelyard (not guaranteed), free; if on scales, 1s. per ton.

Cartages, Rent, Insurance, etc.—Net.

Goods for finishing carted in free; goods for finishing from Lochee, 1s. per load net; goods collected for packing only, cartage to be charged 1s. 6d. per ton, net.

Goods for shipment here to be charged 1s. per ton cartage to shore, net.

Goods finished or made up by us and delivered in town, 1s. per ton, net, to be charged for cartage out.

Goods finished at any associated calendar to be carted free to any other of the associated firms.

Goods received for shipping only and all goods removed in the rough to be charged 1s. 6d. per ton cartage in, and 1s. 6d. per ton cartage out, and 2s. per ton for porterage, net.

Warehouse rent and fire insurance will be charged on all goods at the following rates: For the first month or part of a month, 1d. per ton, net; over 1 month and less than 2 months, 3d.; over 2 and less than 3 months, 6d.; over 3 and less than 4 months, 1s.; over 4 and less than 5 months, 1s. 6d.; over 5 and less than 6 months, 2s., etc. In each specification the average time the goods are in the calendar will be reckoned.

For storing only, goods, yarns, cops in bags, etc., warehouse rent, and insurance, 1s. per ton per month or part of a month; 1s. per ton porterage in and 1s. per ton porterage out, net.

On all the foregoing charges 15 per cent discount to be allowed on all goods wholly jute and tow-warp pack sheets, unless where the rates are marked net.

No discount to be allowed on linen or mixed goods, but 5 per cent additional to the tariff rates to be charged.

PACKING TARIFF—LESS 3 PER CENT.

JUTE GOODS AND TOW-WARP PACK SHEET.

Weight of bales (hundredweight).	Twilled sheet and 2 hoops.		Paper, oil or tar cloth, or paper-lined hessian, twilled sheet, and 2 hoops.		Hoops only.		Customers' own sheet and 2 hoops.		Carpet bales, twilled sheet, and 2 hoops.		Carpet bales, paper, oil or tar cloth, twilled sheet, and 2 hoops.	
	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1	2	6	3	9	1	9	2	1	2	7	3	11
2	3	7	4	8	2	1	2	4	3	10	5	1
3	4	0	5	7	2	4	2	7	4	7	6	3
4	4	5	6	4	2	5	2	9	5	1	7	3
5	4	8	7	1	2	7	3	1	5	7	8	5
6	4	10	7	10	2	9	3	2	6	0	9	4
7	5	2	8	7	2	10	3	4	6	4	10	4
8	5	7	9	4	3	1	3	7	7	0	11	2
9	5	11	10	4	3	2	3	8	7	4	12	5
10	6	3	11	0	3	4	3	10	8	1	13	5
11	6	7	11	10	3	5	4	0	8	7	14	6
12	7	0	12	5	3	8	4	6	9	3	15	5
13	7	3	13	3	3	10	4	9	9	11	16	6
14	7	8	14	0	4	0	5	1	10	9	17	8
15	8	3	14	9	4	3	5	7	11	5	18	9
Each additional hundredweight		8½	1	0		3		4		10	1	4

LINEN, MIXED, AND OTHER GOODS.

	s.	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*	*s.*	*d.*
1	2	11	4	2	2	2	2	4	3	1	4	7
2	4	0	5	6	2	4	2	7	4	5	5	11
3	4	8	6	4	2	7	3	1	5	2	7	2
4	5	1	7	3	2	9	3	2	5	11	8	5
5	5	6	8	3	3	1	3	7	6	4	9	8
6	5	8	8	10	3	2	3	8	7	0	10	9
7	5	11	9	11	3	4	3	10	7	3	11	11
8	6	4	10	9	3	7	4	0	8	1	13	0
9	6	10	11	11	3	8	4	1	8	6	14	4
10	7	2	12	9	3	10	4	5	9	3	15	6
11	7	7	13	6	3	11	4	8	9	11	16	7
12	8	1	14	4	4	1	5	1	10	8	17	9
13	8	5	15	4	4	5	5	7	11	5	18	11
14	8	9	16	1	4	8	5	11	12	4	20	4
15	9	5	17	0	4	10	6	4	13	1	21	8
Each additional hundredweight		10	1	3		3		4	1	0	1	6

Paper, ½d. per sheet. Without ropes or hoops, 6d. per bale less. Hessian sheet, ½d. per hundredweight less than rates for twilled. Bagging sheet, ¼d. per hundredweight less than rates for twilled. Extra hoop, ½d. per hundredweight additional on total weight of bale. Cartage to steamer, 1s. per ton net. Cross ropes or hoops, 6d. per hoop additional, up to 10 hundredweight; above 10 hundredweight, in proportion. Full-width cloth, 65 inches and upward, rate and quarter. Bales having more than two widths, ½d. per hundredweight extra. Boxes: Packing and paper, 2s. 4d. up to 20 cubic feet; larger sizes in exact proportion; boxes in addition, but parties may supply their own boxes. Boards, 1¾d. per square foot of wood used. Trusses under 1 hundredweight to be charged in proportion to rates for 1 hundredweight, but not less than 11d. without hoops. Lags, cloth or wool, 3d. per bale, unless carpet bales. Marking bales more than twice, 3d. extra for each bale.

South American yarn bales, packed in twilled sheet and 2 hoops, to be charged 10 per cent under tariff rates. If ropes are used instead of hoops, 1d. per hundredweight additional to above rates to be charged. Rough jute goods to be charged at linen rates.

SACK SEWING TARIFF—LESS 3 PER CENT.

NOTE.—In calculating prices 0.01 to 0.49, inclusive, will be in favor of the customer, but 0.50 to 0.99 will be in favor of the calender.

OVERHEAD SEAM, JUTE TWINE—BY MACHINE.

Hessian up to 14 ounces, 40 inches, 3s. 2d. per 10,000 inches; above 14 ounces. 40 inches, 3s. 4d.

Bagging under 20 ounces, 42 inches, 3s. 5d. per 10,000 inches; 20 ounces to 24 ounces, 42 inches, 3s. 8d.; for each ounce or part of an ounce above 24 ounces, 1d. additional.

Sacking up to 16 ounces 27 inches, 3s. 5d. per 10,000 inches; above 16 ounces and under 19 ounces, 27 inches, 3s. 8d.; 19 ounces to 21 ounces, 27 inches, 3s. 11d.; for each ounce or part of an ounce above 21 ounces, 1d. additional.

Bagging and twilled woolpacks, with jute twine, 5s. 6d. per 10,000 inches.

Twilled tarpaulin or bagging bags under 60 inches of sewing, 5s. 11d. per 10,000 inches; but if laid in at bottom as well as side, 6s. 2d. If safety seam sewed, 2s. 1d. per 100 bags extra.

Tarpaulin up to 18 ounces, 45 inches, 3s. 4d. per 10,000 inches; above 18 ounces up to 20 ounces, 45 inches, 3s. 7d.; for each ounce or part of an ounce above 20 ounces, 1d. additional.

Bags, overhead seam, laid in both sides, or side and bottom, 7d. per 10,000 inches extra.

Hop pockets, unhemmed ex 24-ounce cloth, sewed with ordinary hemp twine, 11s. 7d. per 100; ex 28-ounce cloth, 12s. 9d. per 100; and all turning of hop pockets to be ½d. each, and all above 28-ounce to be charged 3d. per ounce additional. If Italian hemp twine, 3s. 8d. per 100 extra.

Cop bags, not less than 1⅛d. each, without handles; with handles 1½d. each; if with eyelets, ⅛d. per hole additional.

For all of foregoing, hemming one-half.

OVERHEAD SEAM, JUTE TWINE—BY HAND (3 TO 4 STITCHES PER INCH).

Hessian up to 12½ ounces, 40 inches, 6s. 1d. per 10,000 inches; over 12½ ounces. 40 inches, 1d. additional for each ounce or part of an ounce; over 4 stitches per inch, 6d. per 10,000 inches additional. Hemming, one-half.

Pig wrappers, with 14 eyelets, 7s. per 100; with 16 eyelets, 7s. 7d.; with 18 eyelets, 8s. 3d.; with 20 eyelets, 8s. 9d.; if above 10 ounces, 40 inches, 1d. per 100 wrappers for each additional ounce. Supplying and inserting brass eyelets, up to size 24, ¼d. each; up to size 27, ⅜d. each; up to size 30, ½d. each. Tabs and rings not less than ¾d. each.

Canvas ore bags sewed with flax twine, 1$\frac{2}{12}$d. per 100 inches of actual seam; if twine left at mouth, 2d. per 100 bags to be added.

Dowlas, sheeting, and seed bags, not less than 6s. 9d. rate; hemming, one-half; small quantities and sizes, usual extra; no bags of this description to be sewed under 3s. per 100.

Hemp twine, 1s. 3d. per 10,000 inches additional to rates for jute.

Sacks sewed with hemp waster, 2s. 5d. per 10,000 inches additional to jute.

Hand sewing twills, baggings, tarpaulins, etc., jute twine, 8s. 3d. per 10,000 inches; ordinary hemp twine, 9s. 6d. per 10,000 inches; if hemp waster, 10s. 8d. per 10,000 inches. Hemming to count one-half.

Double hand sewing bagging, sacking, tarpaulin, and T. W. hessians, 1¼d. per 100 inches of single seam. Hemming to count one-third.

UNION SEAM, FLAX TWINE.

Hessian up to 14 ounces, 40 inches, 4–5 stitches, 2s. 6d. per 10,000 inches; 5–6 stitches, 2s. 10d.; 6–7 stitches, 3s. 3d. Hessian above 14 ounces, 40 inches, light bagging, tarpaulin, etc., 4–5 stitches, 2s. 10d. per 10,000 inches; 5–6 stitches, 3s. 2d.; 6–7 stitches, 3s. 7d. Hemming, one-half. Double sewing unhemmed bags, rate and two-thirds. Double sewing hemmed bags, rate and half.

Biscuit bagging up to and including 4 ounces, 40 inches, double rate; above 4 ounces, 40 inches, and up to and including 6 ounces, 40 inches, rate and half.

Round bottom bags to be full tariff rates and 4s. 3d. per 100 extra; thus, 19 by 84 ex 39-inch cloth would be 7s. 9d. per 100.

Yeast bags up to 12 by 16, single seam, 1s. 3d. per 100; if with round bottoms, single seam, 2s. 1d. per 100.

Cotton scrim bags, rate and half.

Union sewed bags, lined with cotton, double rate to be charged.

DOUBLE SEAM (ONE-HALF MACHINE FLAX TWINE, ONE-HALF HAND, OR OVERHEAD MACHINE JUTE TWINE).

Hessian up to 12 ounces, 40 inches, 6s. 5d. per 10,000 inches; tarpaulins up to 20 ounces, 45 inches; baggings up to 22 ounces, 45 inches; and sackings up to 17 ounces, 27 inches, 6s. 10d. per 10,000 inches; 1d. additional for each half ounce or part of half ounce over the above weights. Hemming, one-third. Hemp or flax twine, 1s. 3d. per 10,000 inches additional.

Yeast bags up to 11 by 16, 3s. 1d. per 100; yeast bags, square bottoms, double needle sewed, 9¼ by 13½, 1s. 6d. per 100; 11 by 16, 1s. 7d. Yeast bags, double seam, up to and including 9½ by 13½ may be done at 2s. 11d.; above that size rate must be 3s. 1d. per 100.

SAFETY SEAM.

Overhead and union seam rates, added together.

Hemming to be reckoned separately at one-half of overhead rate.

Sacking, bagging, tarpaulin, etc., bags, safety seam, heavy jute twine or heavy flax twine, to be not less than 4s. 9d. per 10,000 inches; the overhead sewing and hemming to be charged at usual rates.

General.

Canvas or heavy ore or paper-lined bags, sewed lockstitch with heavy flax twine, to be charged 9s. 6d. per 10,000 inches; if double seam, rate and half. Hemming, same rate as sewing. Bags under 60 inches of sewing and hemming to be reckoned ore bags.

Canvas or padding ore bags, double sewed by hand, 1½d. per 100 inches of single seam; if half hand, half machine, 1¼ d. per 100 inches of single seam.

Sacking ore bags, double hand sewed, up to 21 ounces, 27 inches, 1d. per 100 inches of single seam; if half hand, half machine, $\frac{10}{12}$d. per 100 inches of single seam; if above 21 ounces, 27 inches, 1⅛d. and ⅞d., respectively.

Lugs stitched across bottom corners, 1s. 4d. per 100 bags.

Twine attached to mouth of bags, 1s. 3d. per 100 bags and the cost of twine additional.

Bags under 60 inches of sewing (except twilled, tarpaulin, or bagging bags by overhead machine), or lots of less than 200 bags to be charged extra, but not less than 6d. additional to above rates per 10,000 inches, or as 60 inches and 200, respectively.

No bags to be sewed under 1s. 3d. per 100.

Hemming only, 2s. 7d. per 10,000 inches.

Double bags to be charged as two separate bags, and $\frac{1}{12}$d. per bag additional for putting one inside the other; if union sewed, counterlaid, $\frac{1}{18}$d.

Double bags hemmed together, the sewing and hemming to be charged as two separate bags.

Lined bags to be charged double rate; that is, where the cloths are sewn at one operation. This clause does not apply to paper-lined bags.

Hessian woolpacks, 5s. per 10,000 inches for overhead seam; union, 4s. 4d.

Stitching hessian with jute twine or heavy flax twine, not less than 3s. 9d. per 10,000 inches; hessian, 14 ounces, 40 inches or over, and other heavy goods, not less than 4s. Hemming, one-third.

Sewing ore bags T seam, up to 12 by 20 inches, $\frac{11}{18}$d. per bag; from 12 by 20 to 16 by 24, ¾d. per bag; above 16 by 24, 1d. per bag; if not sewn at mouth and no string left, 6d. per 100 less.

Twilled woolpacks or sheets, etc., where sewed with fell seam, such felling to be charged 2s. 10d. per 10,000 inches.

All bags sewed with tarred or dyed twine, 3d. per 10,000 inches extra.

The above prices include making up in suitable bundles for packing. Sacks forwarded loose to be charged ¾d. per bundle, up to 80 pounds, for extra tying and twine; above 80 pounds, in proportion.

Unrolling or running down Calcutta or other goods previous to sewing, 1d. per cut of 100 yards.

It is recommended that for cutting of bags 2½ inches be allowed, at least, upon all tarpaulin, bagging, and sacking up to 19/27; if above that weight, 3 inches. If less cutting is allowed, responsibility will not be undertaken for size. Hessian, 6 ounces, 40 inches, and under, 4 to 5 inches to be allowed. Light hessian, 6 to 8 ounces, 40 inches, 2½ to 3 inches to be allowed; about 8 ounces, 2 inches.

Hessian sheets, single sewed by union machine, ¼d. per yard. Hemming to be reckoned as sewing. Hessian sheets, double sewed, flat seam, by machine, ½d. per yard of seam. Hemming to count as one seam.

Stamping—Less 3 Per Cent.

Machine stamping in black, ⅛d. per impression, but minimum charge to be 2s. 6d.

By stencil in black, plate provided by customer, $\frac{1}{12}$d. per impression; if over 576 square inches ⅛d. Small stencil plates containing not more than 144 square inches of stamping may, however, be done for $\frac{1}{16}$d. a side. Minimum charge for stencil stamping to be 1s.

Small hand block, up to 16 square inches, on one side, $\frac{1}{24}$d. per bag.

Stamping one side in black by machine, if lots exceed 3,000 bags at one time, and stamp not over 256 square inches, $\frac{1}{12}$d. per impression. If fancy colors, one-third extra.

Bleachers' bags, stamped on two sides, fancy colors, ½d. each; if black, ⅜d. If stamped in two colors, one black and one fancy, $\frac{5}{24}$d. per side; if both colors fancy, ¼d.

Stamping running numbers on bags, ⅛d. each number stamped, up to four figures. If figures exceed 3 inches in size, ¼d. If over four figures, rate to be in proportion to that for four figures.

If not sewed as well as stamped, bundling and tying to be charged 1½d. per bundle of 60 pounds or under; if for packing, 1d.; over 60 pounds in proportion.

Bags received sewed and required to be turned for inside stamping, ¼d. per bag to be charged extra in the case of hessian, and ½d. per bag extra in the case of bagging, tarpaulin, and sacking bags for turning.

Second-hand bags must not be sent to any calender without previous arrangement as to rates for storage and stamping, but not to be less than rate and half for stamping.

Carting to steamer, 1s. per ton, net. If delivered in town, cartage to be charged 1s. per ton, net.

Accounts.

Accounts to be rendered monthly; cash to be paid within the following month. Goods transferred are subject to all charges, including rent and insurance, and these charges are to be paid by the party transferring. A lien is held over all goods for previous unpaid charges, past due or current, whether in bills or open accounts.

MINIMUM TARIFF—THE TRADES LANE CALENDERING CO. (LTD.), DUNDEE. CLOTH DYEING, STARCHING, AND FINISHING, APRIL 1, 1913.

[The charges effective Apr. 1, 1913, are minimum tariff, plus an additional 5 per cent.]

Jute Paddings and P. S. Hessians, 24 Inches up to 30 Inches.

Dyeing black, soft finishing, no addition to weight, up to 8 ounces, 24 inches, $\frac{5}{16}$d. per running yard 24 inches wide; above 8 and up to 11 ounces, 24 inches, ⅜d. per running yard 24 inches wide; above 11 ounces, 24 inches, $\frac{7}{16}$d. per running yard 24 inches wide. If any addition is made to weight by whatever process, ⅛d. per running yard 24 inches wide to be added to above rates for each ounce or part of an ounce; if over 3 ounces added, double rates to be charged for each ounce after the 3 ounces. If split, 1d. per split cut to be charged additional. If above 24 inches wide, in proportion. Stiffened goods, if lapped, $\frac{1}{24}$d. per square yard additional. If goods finished by us before dyeing, $\frac{1}{24}$d. per yard additional to be charged. Goods without P. S. to be charged on split width and splitting at 2d. per cut.

Jute Baggings, Pocketings, Tarpaulins, Etc., up to $\frac{24}{42}$ Inches.

Dyeing black and making up only, $\frac{8}{12}$d. per pound gray weight; dyeing black and soft finishing, ¾d. per pound gray weight. If starched, ⅛d. per yard for each ounce or part of an ounce added; goods over 36 inches wide, minimum rate for starching, ¼d. Stiffened goods, if lapped, $\frac{1}{24}$d. per square yard additional.

If goods finished by us before dyeing, $\frac{1}{24}$d. per yard additional to be charged up to 40 inches wide; above, in proportion.

Jute Hessian up to 54 Inches Wide.

Dyeing black and making up only, $\frac{3}{4}$d. per pound gray weight; dyeing black and soft finishing, no weight added, $\frac{25}{32}$d. per pound gray weight. If starched, $\frac{1}{8}$d. per yard for each ounce or part of an ounce added; goods over 36 inches wide, minimum rate for starching, $\frac{1}{4}$d.

Hessians, scrims, etc., up to $5\frac{1}{2}$ ounces, 40 inches, dyed black and soft finishing, $1\frac{1}{4}$d. per pound gray weight. Hessians, scrims, etc., above $5\frac{1}{2}$ ounces, 40 inches, up to and including $7\frac{1}{2}$ ounces, 40 inches, to be charged at $\frac{5}{12}$d. per yard 40 inches wide, and other widths in proportion. Stiffened goods, if lapped, $\frac{1}{24}$d. per square yard additional.

If goods finished by us before dyeing, $\frac{1}{24}$d. per yard additional to be charged up to 40 inches wide; above, in proportion. Goods over 54 inches wide, $\frac{7}{8}$d. and $\frac{15}{16}$d., respectively.

Tow Warp and Jute Weft Paddings, 24 Inches up to 54 Inches Wide.

Dyeing black, $1\frac{1}{4}$d. per pound gray weight.

Flax Paddings, 24 Inches up to 54 Inches Wide.

Dyeing black, $1\frac{1}{2}$d. per pound gray weight.

Cotton Warp and Jute Weft Paddings.

Dyeing black, $1\frac{1}{2}$d. per pound gray weight; for every ounce required to be added, $\frac{1}{8}$d. additional per yard. Finishing to be charged additional as follows: Calendering, $\frac{1}{6}$d. per running yard up to 36 inches; above, per square yard. Mangling, up to 25 inches, $\frac{1}{4}$d. per running yard; 26 inches and up to 36 inches, $\frac{5}{16}$d. per running yard; above 36 inches, $\frac{5}{16}$d. per square yard. Stiffened goods, if lapped, $\frac{1}{24}$d. per square yard additional.

Fancy Dyeing.

Jute goods.—Tan brown (including soft finishing), $1\frac{1}{4}$d. per pound gray weight. All weights up to 8 ounces, 40 inches, to be charged not less than $\frac{5}{8}$d. per yard 40 inches wide; other widths in proportion. Tan brown, if slightly stiffened, $\frac{1}{2}$d. per pound additional; tan brown, if hard stiffened, $\frac{5}{8}$d. per pound additional. Other fancy colors (including soft finishing), $1\frac{1}{2}$d. per pound gray weight. If bleached shades, $2\frac{1}{2}$d. per pound gray weight.

Tow warp goods, linen goods, and cotton goods.—Dyeing fancy colors, $2\frac{1}{2}$d. and upward per pound gray weight. Finishing to be charged extra, as previously scheduled. Goods above 65 inches wide to be charged extra as per agreement. Smaller quantities than 2 hundredweight of any color to be charged rate and half.

Dyeing brown or other colors on one side, $2\frac{19}{12}$d. per square yard. Stiffened goods, if lapped, $\frac{1}{24}$d. per square yard additional.

Shrinking, goods up to 8 ounces per square yard, $\frac{5}{12}$d. per square yard; over 8 ounces and up to 16 ounces per square yard, $\frac{1}{2}$d. per square yard; over 16 ounces per square yard, $\frac{5}{8}$d. per square yard. If finished before or after shrinking, such finishing to be charged.

Jute Goods.

Creaming or bleaching, including double chest finishing, $1\frac{1}{2}$d. per pound gray weight. Drying hessians, $\frac{1}{8}$d. per yard up to 40 inches; above 40 inches, in proportion. Drying tarpaulin, bagging, sacking, etc., $\frac{1}{4}$d. per yard up to 40 inches; above 40 inches, in proportion.

Jute Paddings, Hessians, 24 Inches up to 30 Inches.

Stiffened and finished, adding up to 1 ounce on 24 inches, $\frac{5}{16}$d. per yard 24 inches wide; adding up to 4 ounces on 24 inches, $\frac{9}{16}$d. per yard 24 inches wide;

adding over 4 ounces on 24 inches, $\frac{5}{8}$d. per yard 24 inches wide. If above 24 inches wide, in proportion. Splitting to be charged 1d. per split cut extra. If lapped, $\frac{1}{24}$d. per square yard additional. If crisped, 2d. additional per end, or 4d. per cut of 100 yards.

Hessians, Buckrams, Etc., Above 30 Inches up to 54 Inches Wide, Finished or Unfinished.

Starching, adding 2 ounces per square yard, $\frac{5}{8}$d. per square yard; adding up to 6 ounces per square yard, $\frac{15}{16}$d. per square yard; adding above 6 ounces per square yard, $1\frac{1}{8}$d. per square yard. If above 18 ounces, 40 inches, extra to be charged. Bagging and tarpaulin, $\frac{1}{8}$d. per square yard additional. If crisped, 2d. additional per end, or 4d. per cut of 100 yards. If lapped, $\frac{1}{24}$d. per square yard additional.

Collar vanvas, starched only, ducks and hessians, $1\frac{1}{2}$d. per square yard. Heavy goods, $1\frac{3}{4}$d. per square yard.

Gum Finishing.

Hessian up to 14 ounces, 40 inches, $2\frac{1}{2}$d. per square yard; if above, 3d. per square yard. Sacking or bagging, $3\frac{1}{2}$d. per square yard. Sackings to be charged $\frac{1}{12}$d. per square yard extra for rolling. If black, dyeing to be charged extra at tariff rates.

Glue Finishing.

Hessian, $2\frac{1}{2}$d. per square yard and upward. Sacking, 3d. per square yard and upward. If black, dyeing to be charged extra at tariff rates.

General.

Should goods be received crisped and rolled, either for dyeing or for starching, a charge of 3d. per cut of 100 yards to be made for unrolling and uncrisping. If received rolled, full width, 1d. per cut to be charged for unrolling. All goods for starching without P. S., which are split, to be charged as wide goods, and splitting 2d. per split cut additional. All stiffened goods, which are lapped instead of rolled, to be charged $\frac{1}{24}$d. per square yard additional.

All single-piece and two-piece order lots to be charged rate and half. This applies to all the tariff.

Packing tariff for dyed and starched goods to be ordinary calender charges.

Cartages, Rent, Insurance, etc.

All goods carted to steamer, cartage at 1s. per ton to be charged.

Warehouse rent and fire insurance will be charged on all goods at the following rates: For the first month or part of month, 1d. per ton, net; over 1 month and under two months, 3d. per ton, net; over 2 and under 3 months, 6d.; over 3 and under 4 months, 1s.; over 4 and under 5 months, 1s. 6d.; over 5 and under 6 months, 2s.; etc. In each specification the average time the goods are in the calender will be reckoned.

Goods transferred are subject to all charges, including rent and insurance. A lien is held over all goods for previous unpaid charges, whether in bill or open accounts.

Terms: Accounts rendered monthly; cash to be paid within the following month.

OPERATIVES AND WAGES.

The latest official statistics as to the operatives in the jute industry of the United Kingdom are for 1907, which show that in that year the total number of operatives was 39,785. The number, age, and

sex of the operatives in the jute factories at various periods have been as follows:

Years.	Half-timers.			Full-timers.					Total.
	Males.	Females.	Total.	Males.		Females.[1]		Total.	
				Under 18.	Over 18.	Under 18.	Over 18.		
1870	151	447	598	1,594	2,627	.....	12,751	16,972	17,570
1874	1,418	1,875	3,293	3,670	6,444	.....	24,513	34,627	37,920
1878	1,542	1,980	3,522	2,972	6,060	.....	23,800	32,832	36,354
1885	2,000	2,321	4,321	3,116	7,834	.....	26,403	37,353	41,674
1890	1,483	1,465	2,948	3,708	9,217	.....	28,937	41,862	44,810
1895	1,067	1,226	2,293	3,037	9,243	4,695	22,822	39,797	42,090
1904	338	435	773	2,611	9,650	4,419	23,805	40,485	41,258
1907	141	174	315	2,609	9,616	4,423	22,822	39,470	39,785

[1] Number under 18 years of age first stated separately in 1895.

The age at which children can commence work in factories was raised to 12 years by the factory act of 1901, and this had a very noticeable effect on the number of children employed as half-timers in the last two enumerations.

The number of operatives in the jute industry of the United Kingdom was greatest in 1890, since which time there has been a decline. Part of this loss in numbers may be traced to the fewer half-timers now employed and part attributed to improved machinery and organization. However, taken in connection with the reduction in output, these figures show that the British jute industry reached its zenith in 1890.

LARGE PROPORTION OF FEMALE OPERATIVES.

Of the 39,785 jute workers in 1907 about 70 per cent were females and only about 30 per cent males. About two-thirds of these were paid by time and only about one-third by the piece. In India a majority of the jute operatives are males, but they work long hours and at low wages. In order to compete with India other countries are compelled to pay wages so low that they attract only workers who can not make a livelihood in better-paying industries. This is especially true of Dundee, where the men find work in shops, shipbuilding plants, house building, etc., while the women and girls fill the much lower-paid occupations in the jute industry. Jute manufacturing is so well known as a woman's industry that many women from the country and from towns without sufficient home industries are attracted to Dundee, while many Dundee men who can not find an opening in other local industries move to places where they can make better wages than by competing with the women in the jute factories. Up to the age of 18 the proportion of the sexes in Dundee is about normal, for many boys are employed in the mills as shifters, etc., but as soon as they outgrow such work they lose their jobs, and having no prospects in the only occupation for which they are trained they have to start as unskilled laborers elsewhere. For this reason Dundee contains many more women than men, the census of 1911 showing that of a total of 165,004, 91,763 were females and only 73,241 males.

Over half of the women in Dundee are returned in the 1911 census as following some remunerative occupation, the figures showing that

53.8 per cent of all females over 15 years of age are so employed. The number of married women who work is much larger proportionately than in other Scottish towns. In Edinburgh, for instance, 5.1 per cent of the married women work for wages and in Glasgow 5.5 per cent, while in Dundee no less than 23.4 per cent of the married women are so employed. The number of children between the ages of 12 and 15 who work for wages has been largely lessened in late years, and this decrease is especially noticeable in the employment of 12 and 13 year old half-timers in the jute industry.

EFFECT OF OVEREMPLOYMENT OF WOMEN.

"In the Dundee jute industry overemployment of women and underemployment of men are found associated with the highest infant death rate in Scotland, a high illegitimate birth rate, and great poverty," is a statement by the woman president of the Dundee Social Union. The large number of married women employed in the factories and the short period they can afford to stay away from work, together with the crowded and squalid conditions in which so many live, account largely for the high infant mortality. In recent years the municipality and private agencies have done considerable to alleviate this condition by the establishment of day nurseries at which infants can be left while the mothers are at work, by financing special restaurants for nursing mothers where they can get proper food at a nominal cost, by the appointment of women visitors who are competent to give expert advice and assistance, by lectures for mothers on hygiene and domestic economy, and in other ways.

The lot of the unmarried worker is much more favorable than that of the married. In some departments wages run up to £1 ($4.87) a week; 15s. ($3.65) is a common wage in the factory, and 11s. or 12s. ($2.68 or $2.92) in the mill. In Dundee it is very common for young girls, tired of the crowded two-room home, to leave and associate with other girls, three or four of whom club together and have their own home and live very comfortably on their wages. Owing to the scarcity of men many such sets of companions live and work together until the bond is broken by death. There are, of course, many aged and lonely women, and provision for those between 60 and 70 years of age is made by various mortifications and funds that grant a small monthly pension.

AVERAGE WAGES OF OPERATIVES.

The latest complete investigation into the wages of jute workers was made by the Government for the last pay week of September, 1906, and it showed the wages of full-time workers to have been as follows:

Operatives.	Dundee.	United Kingdom.	Operatives.	Dundee.	United Kingdom.
Men, all occupations	$5.25	$5.25	Women—Continued.		
Lads and boys, all occupations	2.68	2.66	Weavers—		
Women:			One loom	$3.41	$3.39
Carders	2.62	2.60	Two looms	3.81	3.65
Drawers	2.76	2.76	All women	3.28	3.26
Spinners	3.00	2.98	Girls, all occupations	2.37	2.35
Winders	3.53	3.53	Average, all jute workers	3.49	3.47

The decreases and increases in the wages of Dundee jute workers since 1890 have been as follows: In February, 1890, there was a 5 per cent increase granted to spinning-mill workers, including reelers and winders, but not weaving factory workers and mechanics. In May, 1892, there was a 5 per cent decrease, and in December, 1899, a 5 per cent increase. From 1900 to 1905, inclusive, there was no change. In February, 1906, there was a general strike and spinners and preparers in March, 1906, were granted a 5 per cent increase. The wages shown above were compiled in September of that year.

In February, 1907, a further increase was asked for and the wages of all workers, including weavers, were advanced 5 per cent, and those of spinners and others on time-work were raised 9d. a week. In January, 1912, a demand for higher wages was lodged with the secretary of the Dundee Spinners and Manufacturers' Association, asking a 10 per cent increase for all paid over 20s. ($4.87) a week and a 15 per cent raise for all paid under that amount. A great lockout of the jute mills followed on April 10, 1912, which was settled by a raise of 2½ per cent on the weekly earnings of spinners and preparers to come into effect June 28, 1912. In the fall there was another demand for increased wages, and the employers granted an increase of 5 per cent, effective October 4, 1912, to all operatives in both mill and factory. In January, 1913, there was a demand for another increase of 10 per cent, and after negotiations an increase of 5 per cent was granted, effective February 28, 1913, to all workers in the batching, preparing, and spinning departments, the maximum increase in any case to be 1s. (24.3 cents). Winding and weaving rates, as well as those for tenters, calender workers, and dye workers, were also increased 5 per cent in most cases, with a maximum raise of 1s. per week.

Next to the Irish flax workers, Dundee jute workers are the lowest paid of all employees in the textile industries of the United Kingdom. The increasing cost of living has caused such dissatisfaction that, with the growing scarcity of local labor due to emigration, to workers going into other occupations, etc., the manufacturers find it more and more difficult to withstand the pressure for higher wages.

LABOR ORGANIZATIONS.

Neither employers nor employees are very strongly organized. The manufacturers are rather jealous of each other. For instance, it is rare for one manufacturer to allow another to visit his plant, and it is difficult to get them to take any concerted action. A majority belong to the Dundee and District Spinners and Manufacturers' Association, but some of the largest refuse to join, and act independently in wage and other disputes with the workers.

The first of the two principal operatives' unions was founded in 1885 and is called the Dundee and District Mill and Factory Operatives' Union. It had a membership in 1910 of 5,111 women and 1,226 men, and is purely a local society. It is managed by a clergyman, who in some instances has been able to persuade manufacturers to increase wages without the necessity of a strike. The weekly assessment is a penny (2 cents). The second society, the Dundee and District Union of Jute and Flax Workers, was organized in 1905 along the lines of affiliated union work and had a membership in 1910

of 4,000 women and 1,097 men. There are also small unions at Kirkcaldy, Forfar, Arbroath, and Aberdeen.

Wages have advanced since the publication of the 1906 figures previously given, and the present wages are shown in the wage list of a typical jute mill (see p. 134). Wages of jute workers are so much below those of cotton and wool workers that demands for an increase are expected by the employees in the near future, especially if there is a continuance of the present prosperity. There is no uniform wage schedule among the jute mills and considerable variations are found from mill to mill; the scale shown for the typical mill referred to is said by a mill expert to represent a fair average for to-day.

HOUSING CONDITIONS.

Housing conditions in Dundee, as a whole, are and always have been very poor. Over 63 per cent of the inhabitants live in houses of two rooms or less, the result of the expensive stone tenement system, which tends to overcrowding. The advantage of a fairly large kitchen is neutralized by the habit of having a bed in it, always used in preference to "the room." In the newer tenements a recess is generally made for the bedstead. In houses of three apartments the parlor sometimes contains an inclosed bed recess; but more generally a folding bed is used. In the newer dwellings the kitchen measures about 14 by 13 feet and is 11 feet high, with hot and cold water scullery, and the rooms are 12 by 14 feet. The required height is now 9 feet 6 inches on the ground floor and 9 feet on the floors above. Some of the newer tenements are equipped with water-closets in each house, but rarely with a bathroom. In general, however, the closets are on the stairs, sometimes one for each family, more usually one for the two or four families on each floor. Each tenement is supplied with a washhouse and some kind of back space or drying ground. The drying of clothes is accomplished by means of a tall pole erected in the rear, to which ropes are run on blocks from the kitchen windows. In rare cases a drying chamber is fitted under ground, with direct ventilation.

Most of the jute operatives live in three or four story tenements without attics. Only a very small proportion live in detached buildings. In Scotland the census definition of a house is any dwelling with a distinct outside entrance from a street, court, or lane, or with a door opening directly into a common stair or passage. One, two, or more rooms inhabited by a family are therefore referred to as a house, whether it be a detached building or a room or suite of rooms in the heart of a big tenement.

In some districts there is much old property, and there are numerous "back lands," that is, houses having no frontage on the street, but connected with it by a passage or narrow alley only, and inhabited by the very poorest class. The blocks facing on the street are often of modern construction, having been built on the site of earlier buildings that have been demolished, while the back-land buildings inside are ancient structures in bad condition. The interior courts are used for ash pits, clotheslines, etc., and are often dirty and noisome. Usually the buildings on the street are inhabited by well-to-do workers, while those behind are the abiding places of the very poorest. Much has been written in recent years about the bad housing conditions of Dundee, and the municipality has made efforts to improve conditions. However no concerted effort has yet been made

at any definite scheme of municipal housing. These conditions are due largely to the crowded area of the burg. Available for the housing of 165,004 people is a burg area of only 4,881 acres, not including 400 acres of foreshore. Allowing for 331 acres of parks and cemeteries and the amount taken by public buildings, railroads, stores, as well as the large estates of the wealthier classes, the land available for housing the bulk of the population is very small.

Rates are paid weekly by the poorer and more transient classes, and usually semiannually by the others, monthly or quarterly payments being rare. A Government inquiry in 1908 shows that of the total population of Dundee 11.3 per cent occupied houses of one room; 51.7 per cent houses of two rooms; 20.1 per cent, three rooms; 6.6 per cent, four rooms, and only 10.3 per cent houses of five or more rooms. It was found that the average rent for one-room houses varied from 2s. to 2s. 3d. (48.7 to 54.7 cents) per week. Some of the backland rooms rented for as low as 1s. 6d. (36.5 cents) per room, while single rooms with bed closet, or two attics, rented for as much as 2s. 6d. (60.8 cents). Two rooms rented for 2s. to 4s. 9d. (48.7 cents to $1.16) according to size and location, three rooms for 5s. 2d. to 7s. 1d. ($1.26 to $1.72), and four rooms for 7s. 10d. to 9s. 5d. ($1.91 to $2.29) according to flat occupied. The rent paid by jute workers averages about 50 cents per room per week, and a majority of the families of workers live in two rooms or less.

COST OF TYPICAL FACTORY.

To show concretely the amount of different machinery required, together with the usual production and wages in a typical Dundee jute factory working on a standard article, the following complete data were obtained from a prominent Scottish textile expert.

SPECIFICATIONS OF ARTICLE TO BE MANUFACTURED.

The article to be made is the standard staple article of manufacture in the jute industry, that is, the 11-porter, 40-inch, 10½-ounce, 13-shot, chested-finish hessian. The term porter refers to the reed through which the warp threads pass on the loom and which regulates the number of warp threads per unit of width. At Dundee this reed is reckoned by the number of porters of 20 splits, 2 ends to a split, in the Scottish ell of 37 inches. The warp is spaced 43½ inches wide in the reed, which gives a rough width from the loom of about 41¼ inches, and in finishing this is calendered down to 40 inches. The length of warp laid from the dressing machine is 108 yards, which gives about 101½ yards of rough cloth from the loom, and in calendering this is drawn out to 105 yards. The number of ends in the warp is $11\times20\times2\times43\frac{1}{2}$ divided by 37, or 516, of which 508 are usually of jute and 8 of cotton for the selvage. The shots, or picks, in the finished cloth are to be 13 per inch, so that there will need to be inserted $13\times36\times105$ divided by $36\times101\frac{1}{2}$ or, say, 13½ picks on the loom.

The weight of a finished piece of 105 yards will be $105\times10\frac{1}{2}$ divided by 16, or 68.91 pounds. There will be used 8½ pounds per spyndle warp, which after dressing would be 9 pounds per spyndle, and 8½ pounds per spyndle weft.

The weight of warp in a cut figures out as $\frac{11\times20\times2\times43\frac{1}{2}\times108}{37\times14{,}400}$, or 3.88 spyndles. Multiplying 3.88 by 9 gives 34.92 pounds as the weight

of the warp sized, or 3.88 by $8\frac{1}{2}$ gives 32.98 pounds as weight of the warp unsized.

The weight of weft in a cut figures out as $\frac{13\times43\frac{1}{2}\times105}{14{,}400}$, or 4.123 spyndles. Multiplying 4.123 by $8\frac{1}{2}$ gives 35.05 pounds.

Allowing 3 per cent for waste in warp during winding, dressing, and weaving we shall need 33.97 pounds warp, and allowing 5 per cent as waste in weft during winding and weaving we shall need 36.8 pounds of weft, a total of 70.77 pounds of yarn per cut.

In a 600-loom factory, using $46\frac{1}{2}$-inch reed space looms running at 146 picks per minute, the weekly production with 25 per cent allowance for stoppage is $\frac{600\times146\times60\times54}{13\times36}\times0.75$, or 454,846 yards, which is 4,332 cuts of 105 yards each, or 7.22 cuts per loom. The total weight of finished cloth turned out per week would be 4,332 times 68.91, or 298,518 pounds.

The $8\frac{1}{2}$ pounds per spyndle warp required from the spinning room will be $4{,}332\times33.97$, or 147,158 pounds, and the $8\frac{1}{2}$ pounds per spyndle weft $4{,}332\times36.80$, or 159,418 pounds, a total of 306,576 pounds.

The yarn is spun upon flyer frames 4-inch pitch and 4-inch traverse. The warp spindles are operated at 3,300 revolutions per minute, inserting $4\frac{1}{2}$ turns twist per inch, while the weft spindles are operated at 3,100 revolutions per minute with $3\frac{1}{2}$ turns twist per inch.

The production per spindle per week of 54 working hours with 15 per cent allowed for stoppage would be as follows: Total warp per week $\frac{3{,}300\times60\times54\times8\frac{1}{2}}{4\frac{1}{2}\times36\times14{,}400}\times0.85$, or 33.11 pounds per spindle; total weft per week $\frac{3{,}100\times60\times54\times8\frac{1}{2}}{3\frac{1}{2}\times36\times14{,}400}\times0.85$, or 40 pounds per spindle.

Using 31 warp frames of 144 spindles, or 4,464 spindles in all, the weekly production would be $4{,}464\times33.11$, or 147,803 pounds of $8\frac{1}{2}$ pounds per spyndle warp. Using 28 weft frames of 144 spindles, or 4,032 spindles in all, the weekly production would be $4{,}032\times40$, or 161,280 pounds of $8\frac{1}{2}$ pounds per spyndle weft. The total yarn production would thus be 309,083 pounds a week from 8,496 spindles.

Using single roving weighing 80 pounds per spyndle the draft on both warp and weft frames making $8\frac{1}{2}$ pounds per spyndle yarn would be 80 divided by $8\frac{1}{2}$, or 9.41.

The roving frames are of 56 spindles each, using 10 by 5 inch bobbins, making 80 pounds per spyndle rove with a twist of 0.8 turn per inch and using a draft of $8\frac{1}{2}$. The $2\frac{1}{4}$-inch diameter drawing rollers are run at 113 revolutions per minute and the spindles at 639 revolutions per minute. The production per spindle per week is $\frac{639\times60\times54\times80}{0.8\times36\times14{,}400}\times0.70$, or 279.56 pounds, allowing 30 per cent stoppage, and the production on 20 frames would be $20\times56\times279.56$, or 313,100 pounds a week, which is a little more than necessary and allows time for cleaning Saturday.

It has been shown that the yarn required from the spinning would be 306,576 pounds a week, and as the oil and water added to the jute, though part of it dries out, will more than counterbalance the loss of weight by waste, the raw jute required to run the mill a week may be taken as 765 bales of 400 pounds, or 306,000 pounds.

COST OF MILL AND EQUIPMENT.

In the mill we can figure on 1 jute opener and 3 jute softeners with 65 pairs of rollers and fitted with batching gear for feeding on the oil and water. The dollop fed into the breaker cards at each round of the clock will be 33 pounds. Ten breaker cards with two pairs of workers and strippers to the card will be used, the 6 by 4 foot cylinders being run at 190 revolutions per minute. There will be required 20 finisher cards, complete circle, using four pairs of workers and strippers to the card, and the 6 by 4 foot cylinders will be run at 180 revolutions per minute. The draft on both breakers and finishers will be about 12. One finisher card supplies one two-headed first and second drawing of the push-bar type and each two-headed second drawing supplies one 56-spindle roving frame of the spiral type, using 10 by 5 inch bobbins.

The following table gives the cast of a jute mill and factory having 8,496 spindles and 600 hessian looms:

Items.	English currency.	American currency.
MACHINERY.		
1 jute opener, at £220	£220	$1,070.63
3 jute softeners, with 65 pairs rollers and batching apparatus, at £330 each	990	4,817.83
10 down-striker shell-breaker cards, 6 by 4 foot cylinders with covers, at £240 each	2,400	11,679.60
20 full-circular finisher cards, 6 by 4 foot cylinders with covers, at £270 each	5,400	26,279.10
20 push-bar first drawing frames, 2 heads each, 4 bosses per head, at £150 each	3,000	14,599.50
20 push-bar second drawing frames, 2 heads each, 4 bosses per head, at £150 each	3,000	14,599.50
20 spiral roving frames, 56 spindles each, 10 by 5 inch bobbins, 10-inch reach, total of 1,120 spindles, at 130s. per spindle	7,280	35,428.12
31 warp-spinning frames, 144 spindles each, 4-inch pitch, 4 by 2½ inch bobbins, total of 4,464 spindles, at 35s. per spindle	7,812	38,017.10
28 weft-spinning frames, 144 spindles each, 4-inch pitch, 4 by 2½ inch bobbins, total of 4,032 spindles, at 35s. per spindle	7,056	34,338.02
12 cop-winding machines, 120 spindles each, making 10 by 1⅝ inch cops, total of 1,440 spindles, at 31s. per spindle	2,232	10,862.03
12 roll-winding machines for warp, 80 spindles each, total of 960 spindles, at 35s. per spindle	1,680	8,175.72
12 yarn-dressing machines, with six 4-foot steel cylinders each, at £340 each	4,080	19,855.32
24 500-bobbin banks, at £25 each	600	2,919.90
5 drawing-in frames, at £4 each	20	97.33
600 overpick hessian looms, 46½-inch reed space, at £24 5s. each	14,550	70,807.58
4 90-inch cropping machines, at £90 each	360	1,751.94
2 90-inch double damping machines, at £65 each	130	632.65
6 90-inch 5-bowled calenders, at £580 each	3,480	16,935.42
1 90-inch patent hydraulic mangle, at £1,200	1,200	5,839.80
6 90-inch measuring machines, at £65 each	390	1,897.93
2 power and 2 hand sack-cutting machines	240	1,167.96
60 sewing machines with tables, etc., at £16 each	960	4,671.84
1 sack printer	60	291.99
2 double 17-inch ram hydraulic presses with one set of 8-barrel pumps	2,500	12,166.25
Total	69,640	338,903.06
Machine ascessories and stores	3,500	17,032.75
BUILDING AND EQUIPMENT, STEAM PLANT, ETC.		
Eight Lancashire shell boilers, 30 by 7 feet 6 inches, with piping and fittings, at £600	4,800	23,359.20
One 2,000-horsepower cross-compound condensing engine	8,000	38,932.00
Two 298-tube economizers with valves, dampers, etc., at £350 each	700	3,406.55
Stokers, feed pumps, and other boiler and engine equipment	700	3,406.55
Engine and boiler seatings	5,000	24,332.50
Chimney	1,400	6,813.10
Electric-light equipment complete	1,000	4,866.50
Pipes for heating, for supplying steam to slashers, etc	500	2,433.25
Shafting, pulleys, hangers, couplings, etc	2,500	12,166.25
Ropes and belting	750	3,649.88
Buildings and miscellaneous	75,000	364,987.50
Total	100,350	488,353.28
Grand total	173,490	844,289.09

The bag-making department and the offices are in a three-story addition, but the main mill is a one-story building. At one end is the jute warehouse, and beside this, in order, the preparing and spinning room, the weave room, and the finishing plant. The mill has brick walls, saw-tooth roof, round iron columns, and cement floor.

The total first cost of a spinning and weaving mill, complete with machinery, buildings, and equipment, comes to £289, or $1,407, per loom. Allowing for land, the first cost may be taken as approximately £300, or $1,460, per loom.

Urquhart, Lindsay & Co. (Ltd.), machinery builders and engineers, state that it is customary at Dundee to figure on the amount of capital required to erect, equip, and operate a complete jute-manufacturing plant at £450 per loom, and taking £300 per loom as the sum required for the complete first cost, this allows £150 as working capital. A large part of this, of course, would be tied up in stock and goods in process, raw-jute supply, and finished goods not shipped.

COST OF OPERATING FACTORY.

The following table gives the wages paid for operating the mill one week:

Operatives.	Weekly wages.	
	English currency.	American currency.
JUTE MILL.	£ s. d.	
1 overseer, at 50s. a week	2 10 0	$12.17
2 assistant foremen, at 25s	2 10 0	12.17
2 men handling bales from warehouse to batching room, at 24s	2 8 0	11.68
4 men at bale openers, at 23s	4 12 0	22.39
8 men stricking up, at 20s	8 0 0	38.93
9 men at softening machines, 6 at 20s. and 3 at 18s	8 14 0	42.34
2 men carting jute, at 20s	2 0 0	9.73
35 operatives around 10 breaker cards, at 14s	24 10 0	119.23
70 operatives around 20 finisher cards, at 12s	42 0 0	204.39
20 drawers, 4 heads each, at 12s	12 0 0	58.40
20 backminders for drawing and roving, at 12s	12 0 0	58.40
20 roving minders, 56 spindles each, at 14s	14 0 0	68.13
1 shifting mistress, at 15s	15 0	3.65
8 roving-frame shifters, at 12s	4 16 0	23.36
3 rove carriers, at 19s	2 17 0	13.87
31 warp spinners, minding 144 spindles each, at 15s	23 5 0	113.15
42 weft spinners, minding 108 spindles each, at 15s	31 10 0	153.29
18 piecers, at 14s	14 12 0	71.05
6 bobbin setters, at 12s	3 12 0	17.52
6 shifting mistresses, at 18s	5 8 0	26.28
48 shifters, at 13s	31 4 0	151.83
3 bobbin carriers, at 19s	2 17 0	13.87
3 list boys, at 13s	1 19 0	9.49
3 oilers, at 16s	2 8 0	11.68
3 sweepers, at 12s	1 16 0	8.76
3 pickers, at 17s	2 11 0	12.41
JUTE FACTORY.		
1 foreman warp winding, at 25s	1 5 0	6.08
1 foreman weft winding, at 25s	1 5 0	6.08
96 cop winders, 15 spindles each, winding 159,418 pounds, or 325,213 spyndles, at 6d. per 100 spyndles	81 6 0	395.64
48 warp winders, 20 spindles each, winding 147,158 pounds, or 300,202 spyndles, at 3d. per 100 spyndles	43 15 7	213.05
12 yarn dressers, at 30s	18 0 0	87.60
12 assistant yarn dressers, at 20s	12 0 0	58.40
4 drawers-in, drawing in 542 beams holding each 8 cuts of 516 ends 108 yards long, at 20s	4 0 0	19.47
4 givers-in, at 8s	1 12 0	7.79
300 weavers, tending 2 looms each, turning off a total of 4,332 cuts a week, at 16½d. per cut	297 16 6	1,449.36

Operatives.	Weekly wages.	
	English currency.	American currency.
JUTE FACTORY—continued.		
	£ s. d.	
20 tenters, at 20s. per week, plus ½d. per shilling on the wages made by the weavers	32 8 2	$157.72
4 croppers, at 24s	4 16 0	23.36
4 assistant croppers, at 22s	4 8 0	21.41
4 dampers, at 20s	4 0 0	19.46
6 calenderers, at 26s	7 16 0	37.96
12 assistant calenderers, at 24s	14 8 0	70.08
2 manglers, at 28s	2 16 0	13.63
2 assistant manglers, at 26s	2 12 0	12.65
6 men at measuring machines, at 24s	7 4 0	35.04
6 boys at measuring machines, at 16s	4 16 0	23.36
4 men at sack cutting, at 22s	4 8 0	21.41
4 boys at sack cutting, at 18s	3 12 0	17.52
60 sack machinists, making piecework about 20s. each	60 0 0	291.99
2 men at sack printer, at 21s	2 2 0	10.22
8 men at hydraulic presses, 4 at 24s. and 4 at 21s	9 0 0	43.80
GENERAL LABOR, MILL AND FACTORY.		
1 engineer, at 50s. per week	2 10 0	12.17
2 oilers and greasers, at 18s	1 16 0	8.76
4 boiler-room men, at 20s	4 0 0	19.47
1 head machinist, at 35s. per week	1 15 0	8.52
3 assistant machinists, at 20s. per week	3 0 0	14.60
4 yard and warehouse men, at 20s. per week	4 0 0	19.47
Total, 1,008 operatives	907 1 3	4,414.23

The preparation and spinning departments require 371 operatives and the weaving and finishing departments 552, which, with 15 men in the engine room, machine shop, yard, etc., makes a total of 938 for only 8,496 spindles and 600 looms. This is several times the number required for a cotton factory with the same number of spindles and looms. With the 70 operatives required in the bag-making department, a total of 1,008 operatives is needed for the complete establishment.

At Dundee there is no uniformity about wages, either by day or the piece, and in this, as well as in the number of operatives to a machine, great diversity prevails. For instance, instead of the 108 spindles here shown tended by each weft spinner, many mills have only 72 spindles to the girl, while in some cases, usually with frames at a lower speed or a greater twist, each girl may be given as many as 144 weft spindles on such counts. The above figures, however, are given as representative of the better-managed factories that obtain the best class of help and the highest production by paying what in Dundee are considered full wages.

COMMERCIAL QUOTATIONS.

In buying and selling at Dundee jute is quoted per ton of 2,240 pounds, fine yarns per spyndle of 14,400 yards, coarse yarns per pound and rove per ton, cloth per yard, and bags per hundred. In the table following are the Dundee quotations on the staple articles as shown in the Dundee Prices Current and Trade Report on the 1st day of January for the past 15 years.

Years.	Raw jute.						Jute yarns.						Jute cloth.							
	R. F. Block–D.		First marks.		Daisee.		8-pound common cops.		8-pound medium warp.		24-pound sacking weft.		Hessians.				74-inch, 10-porter, floor-cloth.		45-inch, 11-porter, 20-ounce tarpaulin.	
													40-inch 10½-ounce.		40-inch 8-ounce.					
	£	s.	£	s.	£	s.	s.	d.	s.	d.	d.		d.		d.		d.		d.	
1899	14	5	12	15	11	10	1	2¼	1	3½	1 7/16		1 11/16		1 7/12		1 8/12		3 1/2	
1900	17	0	14	5	13	10	1	5½	1	6¾	1 5/8		2 1/8		1 15/16		2 1/4		4 1/16	
1901	15	10	13	0	12	0	1	6¾	1	7½	1 5/8		2		1 7/8		2 1/2	4	3 3/4	
1902	15	10	12	0	11	0	1	3	1	4½	1 7/16		1 3/4		1 8/12		1 3/4		3 3/8	
1903	16	10	13	10	13	0	1	4¾	1	6	1 9/16		1 13/16		1 8/12		1 7/8		3 3/8	
1904	16	10	13	0	12	15	1	4½	1	5¼	1 17/32		1 13/16		1 3/4		1 10/12		2 3/8	
1905	18	15	16	0	14	5	1	6	1	7	1 9/16		1 7/8		1 13/16		2 1/4		3 5/8	
1906	24	0	19	5	18	5	1	10½	2	0½	2 1/16		2 5/16		2 1/8		2 1/2		4 3/8	
1907	37	0	26	10	25	0	2	11	3	0	2 3/16		2 3/16		2 1/16		3 1/2		5 7/8	
1908	30	0	15	10	15	10	1	8	1	10½	2		2 3/8		2 1/8		2 3/8		4 9/16	
1909	30	0	14	5	14	10	1	5½	1	7¾	1 1/2		2		1 13/16		2		3 13/16	
1910	21	0	14	0	13	15	1	5½	1	6½	1 11/16		1 44/48		1 37/48		1 46/48		3 9/16	
1911	.....		19	15	18	10	1	8½	1	10	2		2 1/8		1 47/48		2 1/4		4 1/16	
1912	.....		20	5	19	0	1	10¾	1	11½	2 3/8		2 16/48		2 47/48		2 16/48		4 5/16	
1913	.....		26	0	23	5	2	7½	2	9	2 13/16		3 3/8		2 44/48		3 3/8		5 13/16	

As RF Block–D is high-grade jute, of which there is little left by the 1st of January, the trade paper ceased quoting it on the 1st of January, 1910. The "First Marks" of the best shippers, though lower than the RF Block–D range of marks, is also high-class jute and is used for the better grade of goods. Ordinary hessian (burlap) is now largely made of Daisee jute, which is numbered 1, 2, and 3, or an equivalent in letters. When something in the Daisee crop is too low for packing in the bales marked Daisee Threes, it is reserved and packed in bales described in Calcutta as Daisee Fours, which, in Dundee are usually called Daisee X Threes or Daisee Cross Threes. The quotations above are on Daisee Twos.

CHANGES PROPOSED IN QUOTATIONS.

Yarn and cloth have always been quoted on the Dundee jute exchange in vulgar fractions—halves, quarters, eighths, sixteenths, and forty-eighths of a penny. At its meeting in January, 1911, the Dundee Chamber of Commerce came to the conclusion that this system was too antiquated and cumbersome to be retained in modern commerce, and the trade was circularized as to its wishes in the matter. It was proposed that the vulgar fractions be superseded by two-place decimals and, furthermore, that jute cloth should be quoted per ounce and jute yarns per pound. A proposition was also made that Dundee should quote hessians on the Calcutta system of the hundred yards instead of the present system of the yard. In regard to substituting decimals for fractions of pence, the replies showed that, though some were rather violently opposed to any change from the time-honored system and some were indifferent, the great majority were in favor of the labor-saving reform and would prefer to quote in decimals. Quotations are sometimes now given in both decimals and vulgar fractions, but in spite of the trend in its favor the vulgar fractions up to forty-eighths are still most used.

MARGIN BETWEEN RAW MATERIAL AND FINISHED PRODUCT.

Raw jute is quoted in pounds and shillings per ton of 2,240 pounds, yarn in shillings and pence per spyndle of 14,400 yards, and cloth in pence per yard; hence it is difficult from the quotations to gain any idea of the margin between them. In the following table I have reduced the prices for raw jute and for the standard 10½-ounce, 40-inch hessian to cents per pound, to show what margin there is between the raw material and the finished product:

Years.	Price per pound.		Margin, jute to cloth.
	Raw jute, Daisee 2.	10½-ounce, 40-inch hessian.	
	Cents.	*Cents.*	*Cents.*
1899	2.464	5.142	2.678
1900	2.892	6.476	3.584
1901	2.572	6.096	3.524
1902	2.356	5.334	2.978
1903	2.786	5.524	2.738
1904	2.732	5.524	2.792
1905	3.054	5.714	2.660
1906	3.910	7.048	3.138
1907	5.358	6.666	1.308
1908	3.322	10.286	2.964
1909	3.108	6.096	2.988
1910	2.946	5.842	2.896
1911	3.964	6.476	2.512
1912	4.072	7.110	3.038
1913	4.982	10.286	5.304

Each January price reflects to some extent the margin obtaining during the latter part of the previous year and the foregoing table brings out clearly the comparatively large margins during the boom years of 1907 and 1912, while the latter part of 1906 and 1910 were evidently periods of great depression.

CONSTRUCTION OF VARIOUS JUTE GOODS.

Most jute cloths are woven plain or in simple twills. The four chief makes of jute cloths are hessians, baggings, sackings, and tarpaulins. In addition to these, which beside other uses provide practically all the material for the various kinds of bags, a large amount of wide cloth is made for the foundation of linoleums and other kinds of floorcloths and a fair amount of the ordinary widths is dyed in art shades and used for wall decoration. There is also a substantial trade in paddings, in plain and fancy stair carpeting, and in Brussels, Wilton, Axminster, and other kinds of carpets.

HESSIAN OR BURLAP.

The following are the ordinary constructions of some of the chief hessians, finishing 40 inches wide, as shown in a table printed by William Leggatt, of Dundee:

Porter.	Ounces per yard.	Width.	Ends warp.	Shots weft.	Warp laid.	Cloth from loom.	Cloth finished.	Size warp.	Dye warp starched.	Size weft.	Weight of warp in cut.	Weight of weft in cut.	Weight of finished cut.
		In.			*Yds.*	*Yds.*	*Yds.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*	*Lbs.*
8	6	40	380	9½	108	106	107	7	7½	6½	21½	19	40½
8½	6½	40	400	9	108	106	107	7	7½	7	22½	21	43½
9	7	40	420	10	108	105	106	7	7½	7½	22½	24½	47
9	7½	40	420	10	108	105	106	8	8½	7	27	23	50
9	8	40	420	11	108	104	106	8	8½	7½	27	26½	53½
10	8	40	468	11	108	104	106	7	7½	7½	30	26½	56½
10	8½	40	468	11	108	104	106	8	8½	7½	30	26½	56½
10	9	40	468	11	108	103	106	8	8½	8	30	29½	59½
10	9½	40	468	12	108	103	105½	8	8½	8½	30	32¼	62¼
10	10	40	468	13	108	103	105½	8	8½	8½	30	36	66
11	10½	40	516	13	108	102	105	8	8½	8¾	33	36	69
11	11	40	516	13	108	102	105	8	8½	9¾	33	39½	72½
11	11½	40	516	13	108	101	105	8	8½	10¼	33	42½	75½
11	12	40	516	13	108	100	105	8	8½	11¼	33	46	79
11	12½	40	516	13	108	100	104	8	8½	12	33	49	82
11	13	40	516	13	108	100	104	8	8½	13¼	33	52	85
11	13½	40	516	13	108	99	104	8	8½	13¾	33	55	88
11	14	40	516	13	108	99	104	8	8½	14¼	33	58	91

The foregoing table gives an idea of the relation of various makes of hessians to each other, but different firms attain the same result in different ways. For instance, on the 11-porter, 10½-ounce standard hessian above given, Leggatt shows the use of 8¾ pounds per spyndle weft where many firms use 8½ pounds per spyndle; similarly, he shows the use of 8 pounds per spyndle warp sized up to 8½ pounds, whereas in the majority of mills it is more customary to use 8½ pounds sized up to 9 pounds per spyndle warp. The shots weft per inch shown above are the shots in the finished cloth, and owing to the stretch in finishing the actual shots per inch inserted on the loom will be somewhat larger. As a rule, it is better to make cloth for 12 ounces, 40 inches, and upward, say, to 16 ounces, 40 inches, with 9 pounds per spyndle warp, as it fills up better in the finishing and the extra strength in the warp is a help to the weaver, especially if the looms work fast, say, 145 to 150 picks per minute.

Hessian is the most widely manufactured of all jute fabrics and is used for a great variety of purposes; it is always made of single yarns and plain woven. As shown in the table, the usual width is 40 inches and the usual extremes of weight are 6 ounces and 14 ounces per yard. In most cases no variation is made in the set of the fabric, nor in the count of the warp, for an increase in weight above 10½ ounces, this being obtained by simply changing the weft; below 10½ ounces per yard it is usual to alter the set as well as the yarn counts.

Mangled hessian is a fabric similar to the ordinary hessian, but differently finished to give it a smoother and more glazed appearance. In some cases the same yarns are used and the only difference is in the finishing, but in other cases higher quality material is used.

TARPAULIN.

Tarpaulin is a plain fabric made with taped warp, usually called D. W., or double warp, in the jute trade; that is, two warp ends are drawn in and woven side by side as one end. The standard width is the 45-inch, prices being usually based on a 45-inch, 10-porter, 20-ounce per yard D. W. tarpaulin, with 12½ shots per inch finished. Such cloth would be spaced 48 inches wide in the reed to finish 40 inches, and the laid length would be 108 yards to finish 103 yards. It would require about 14 pounds per spyndle weft, and warp 8½ pounds dry or 9 pounds per spyndle dressed. Tarpaulins are waterproofed by applying a thin coating of boiled tar. Formerly most tarpaulins were made of hemp or coarse flax, but the comparative lightness, toughness, and cheapness of jute have given it the preference for such goods. For general purposes the tar is painted over only one side, but heavy tarpaulins are sometimes coated on both surfaces. The tar must be applied as hot as possible, and it is advantageous to have the canvas heated over a metal plate kept warm with steam or metal heaters. The fabric is wound tightly on a large roller and the portion under treatment is pulled over the hot plate. The tar is discharged over a pair of small rolls that serve as spreading rolls, or it may be painted on to the stretched fabric by two workmen, one on each side of the sheet, who apply a thin coating over half the width of the fabric. They hold a brush in one hand and a flat rule in the other to strike off the superfluous tar and distribute the layer more evenly over the surface. As soon as the tarpaulin is coated it is hung up for some time in a well-ventilated shed in order that certain of the volatile matters may be given off and the material lose its pungent smell. After seasoning it may be rolled up or folded for use, but it is dangerous to fold together freshly made tarpaulins, as in this condition they are liable to heat and might even occasion spontaneous combustion. The coating with tar is usually carried on separately by an outside firm.

BAGGING AND SACKING.

D. W. bagging is a double-warp plain fabric, but of a different class from tarpaulins, as the set is usually much coarser and the count of the weft heavier. The standard width is generally taken as 44 inches. A common D. W. bagging is made 7-porter, 44-inch, 24-ounce per yard, 9 shots per inch finished, of 8¼ pounds per spyndle undressed and 38 pounds per spyndle weft. The laid length is 108 yards to finish 102 yards and the reed width 46½ inches to finish 44 inches, the bagging being used in the condition in which it comes from the loom. The jute bagging for covering cotton bales, usually called cotton bagging in the South, is ordinarily 32 ounces per yard, 44 inches wide, and the yarns are mainly made of jute butts or cuttings (the woody and hard root ends of the jute plant), which ordinarily cost only about 1 cent a pound. Each bale of cotton requires an average of 6½ yards of bagging, and the total American crop requires nearly a hundred million yards of bagging annually. Dundee, however, obtains a comparatively small proportion of this trade, as the manufacture of jute bagging in the United States is sufficient for the ordinary crop. This is not the case with burlap, of which the United States manufactures little and imports immense quantities.

Twilled sacking is a double-warp fabric, woven with the regular three-leaf twill, two up one down, and having three double or six single threads of warp per split in the reed. Prices are usually based on the 27-inch width, 8 porter, 16 ounces per yard.

BAG MANUFACTURE AND TRADE.

Jute is the material used in making the bulk of the world's bags and sacks, and this is a very important trade at Dundee. However, owing to the overshadowing manufacture of bags at Calcutta, Dundee has never been able to attain again the record made in 1881. Elsewhere are given statistics as to the number and value of bags exported from Dundee to various countries, showing a total export in 1912 of nearly 50,000,000 bags in addition to the quantity used at home. Part of these bags are made by the mills and part by separate firms. Most of the bags and sacks are sewn by machine, but for some purposes the hand sewn is preferred. Part of these are given out to home workers, and it is a common sight in Dundee to see a woman carrying to the factory a 60-pound bundle of sacks she has sewn. Such work is done by the very poorest class, and the remuneration is so small that only by hard work can they make as much as a shilling (24.3 cents) a day. On the other hand, women at the factory who sew the burlap, after it is cut up by hand or machine, into sacks, using either a straight or overlock sewing machine, make higher wages than women in either the mill or the factory, and average about 20s. ($4.87) a week. Some expert "sack machinists," as they are called, make up to 30s. ($7.30) a week.

Bags and sacks are used for many purposes, and many different sizes are made from cloths of constructions and weights that vary according to the purpose for which required. The following is a partial description of some of the types of bags most largely made at Dundee:

Kinds.	Size.	Weight.	Cloth.	Porter.	Pounds per spyndle.	
					Warp.	Weft.
	Inches.	*Pounds.*				
Buenos Aires grain bags.	22½ by 40	[1] 12½	Plain	10	8	8
Grain sacks	30 by 60	3½ and 5	D. W. twill	6		
Wheat sacks	22 by 36	[1] 12	Plain	10	8	8
D. W. flour bags	28 by 56	2½	D. W. twill	7		
Sugar pockets	18 by 27	1⅛	Plain	8		
Sugar bags	26 by 48	2½	do			
Twilled sugar bags	28 by 48	2½	Twill			
Cuban sugar bags	29 by 48	2½	do	7	10	
Bran bags	27 by 49	1⅛	Plain	8		
D. W. salt bags	26 by 45	1¾	D. W. twill	6		
Onion pockets	22½ by 40	[1] 12	Plain	9	8	8
Seed bags	20 by 40	[1] 11¼	do	10	8	8
Railway sacks	28 by 56	4	Twill	10	9	28
Twilled ore pockets	20 by 30	1½	do	8	9	36
Nail bags	16 by 24	[1] 14				
Manure bags	24 by 40	[1] 13½	Plain	10	8	8
Australian corn sacks.	44 by 26½	2¾	Twill	8	10	30
Ore bags	18 by 27	1¼	D. W. twill	8	10	34
Cement bags	22 by 51	3¼	do	10	8	18
Wool packs	27 by 27 by 54	5, 8, and 10	do	8	10	45
Cape wool packs	27 by 27 by 54	8½	do	8	10	36
Cotton packs	45 by 85	3 and 3¼	Plain	9	9	10

[1] Ounces.

FLOORCLOTH MANUFACTURE AND TRADE.

Oil floor coverings are made by applying some composition of linseed oil to a textile foundation. The foundation material is usually wide widths of jute hessians, and the best known variety of floorcloths so made is called linoleum. This was originally the invention of Frederick Walton, who coined the word descriptive thereof from linum (flax) and oleum (oil), since the new material had for its basis a solidified linseed oil. In 1864 Walton founded at Staines, in England, the first linoleum factory ever built, which was later acquired by the Linoleum Manufacturing Co. (Ltd.), of which Walton was for long the managing director. The manufacture of floorcloth has now become a vast industry, with Great Britain, Germany, and the United States the chief countries engaged therein. The center of this industry in Scotland is Kirkcaldy, though there are also mills at Dundee, Newburgh, and Falkland.

FLOOR OILCLOTH.

Floor oilcloth is composed of a foundation of jute burlap, which, after being sized and rubbed smooth and even, is covered with a mixture of ochre, linseed, and benzine. The surplus material is scraped off by revolving metal blades, and when dry the coating is rubbed smooth with pumice stone. The coating and rubbing are repeated until the desired thickness is attained. The printing of the pattern on the coated fabric was formerly done entirely by hand, but machine printing is now customary. In printing by machinery the cloth passes over a flat table and under wooden blocks which have a rising and falling motion. The pattern is carved on the wooden blocks and a separate block is required for each color. The color is applied to the block, when in the raised position, by means of a roller. After printing and drying, the surface is varnished and the cloth trimmed and rolled up ready for the market.

LINOLEUM.

Linoleum is composed of a foundation of jute burlap, on which is fastened evenly and thoroughly a cement composed of solidified linseed oil mixed with cork, kauri gum, resin, and pigments of various kinds. The cork used is the waste from the manufacture of bottle corks ground up into dust.

In making linoleum the chief problem is to solidify the linseed oil. Walton solved this by suspending immense sheets of very thin cotton scrim from the roofs of extensive sheds, in which a temperature of about 100° F. was maintained, and the oil after being boiled was permitted to trickle down the surface of the scrim. It was then pumped up to the top and so used over and over again until a thick coating of the oxidized oil, then called a skin, had become deposited. The whole mass of oil and scrim was then ground up by machinery, the oxidized oil so produced being melted in steam-heated pans with kauri and other resins, the whole forming a substance in the nature of an india-rubber substitute. After the addition and thorough incorporation of powdered cork and coloring matter, it was spread in uniform thicknesses over sheets of prepared jute

backing. A more expeditious process for oxidizing the oil is now largely used by causing thin streams of the boiled linseed oil to fall to a tank from a considerable height, this operation being repeated over and over again until the oil becomes thick enough for further treatment, during which it is passed through other machines and finally obtained in the form of a gelatinous mass. Before it is ready for use, linoleum has to be seasoned, or matured, by being subjected for some weeks to a moderate heat in stoves kept at a uniform temperature. In the course of this operation certain of the volatile ingredients are evaporated and the oxidization of the oil is completed and the linoleum fully indurated.

If the linoleum is to be plain, that is, of a uniform color, the coloring matter is added to the mixture before it is rolled on the burlap. If the linoleum is to bear a pattern, this is printed on the surface by means similar to that employed in printing floor oilcloths. In mosaic, or inlaid, goods the colors go through to the back of the cloth, and with linoleum so made there is no possibility of the colors wearing away and becoming shabby. Inlaid linoleum is made in various ways, there being special patented processes. In general, however, the process consists of cutting rolls of linoleum cement of various colors into separate pieces by disks and then rolling them into place on the burlap backing with hot rollers. This is done by machinery, and as knife-edged cutters, or punches, of the requisite shape separate from the different colored rolls the pieces required to form the selected pattern, plungers actuated by cams force them from the cutter and attach them by needle points to an endless band, which carries them forward to the inlaying machine. This consists of a large drum, or cylinder, of metal some 12 feet in diameter, on which the pieces forming the pattern are automatically assembled in their relative positions by the machine, the linoleum being attached to the jute backing by means of cement and the whole passed between heavy rollers. Walton originally called this new material mosaic linoleum. After drying, the backing is treated with a preparation of resin and other ingredients to make it waterproof. In some processes the different colored linoleum cements ground into powder are dropped on the backing in the desired arrangement, and the powdered covering is then subjected to heavy pressure from a heated plate until it is completely fused and firmly attached to the backing.

GRANITE LINOLEUM.

Besides the plain, printed, and inlaid linoleum described, there are two others. Granite linoleum is made with pastes containing masses or spots of different colors. The colors remain separate in the completed fabric, but the assemblage and relation of these variously colored spots and masses are casual. Plank linoleums, oak plank linoleums, or plank inlaid linoleums are made by running upon the burlap paste of two colors in equal stripes, the materials being kept from mixing and the effect somewhat resembling a floor inlaid with alternate planks of different woods. The pastes are pressed into and firmly united with the cloth by hot rollers. In some cases the pattern is painted on with the aid of stencils instead of by printing rollers.

CORTICENE, KAMPTULICAN, AND LIGNITECT.

Corticene is prepared in a manner somewhat similar to linoleum, but the linseed oil is oxidized differently and rubber is also usually employed in the composition. Cork carpet, or Kamptulican, resembles plain linoleum and is made in the same manner, except that the cork used is not ground so finely and in the mixture of linseed oil, ground cork, and other materials the proportion of cork is larger and the result is a softer, more spongelike substance. Lignitect is a fabric resembling linoleum, except that ground wood is used in place of ground cork, the woods most commonly used being white poplar and horse chestnut.

In all of these floor coverings the basis is wide widths of jute fabric, and at both Dundee and Calcutta a steadily increasing number of looms have been put on such goods.

JUTE SUBSTITUTES.

While jute is the cheapest of all the principal textile materials now in use, it is very perishable in its nature, and attempts have been made to find substitutes that will either be cheaper or else almost as cheap and more durable. Jute fiber is weak and decays easily, especially if exposed to moisture, and it holds its position as the wrapping material of the world because of its cheap production and the ease with which it can be worked with the machinery. It is by no means the highest representative of its class, and attempts have been made from time to time to get growers and manufacturers to try other fibers of India that can, it is claimed, be grown just as easily and over a wider area. Possibly something may come of such experiments, but unless grown on a large scale, such fibers can not compete with jute in price, and the ryots who now cultivate jute are not looking for substitutes.

BOMBAY HEMP—SEAWEED.

The only Indian fiber now competing with jute at all is the Madras Presidency *Hibiscus cannabinus*, commonly called Bimlipatan jute or Bombay hemp. It is quite similar to jute, and though the bulk of it is used in a mill at Madras, occasional shipments are made to Dundee, where it is used for mixing with jute proper. It is improbable that Madras can compete with Bengal to any large extent, though in the future there may be a fair development of this fiber.

Periodically one sees reports as to new competitors of jute, which are exploited to a certain extent and then drop out of view. For instance, in 1910 English textile and trade papers took quite an interest in the rumored exploitation of a seaweed called *Poseidonia australis*. This fiber is the accumulation of centuries of a marine plant, and it is claimed there is a 9-foot depth of it located under the sea in Spencer Gulf, South Australia. A company prospectus was issued to raise capital for its working, with claims that it could be put on the market much more cheaply than jute and would be a formidable competitor, but Dundee manufacturers state that the samples show a short fiber and they see little possibility of its use.

PAPER YARNS.

Paper yarns have been experimented with in Germany for some time with a view to making them an effective substitute for jute. Partial success at least seems to have been achieved by the invention of textilose, which is a paper yarn coated with a textile material, and it may possibly in time occupy somewhat the same relation to the jute trade that artificial silk does to the silk trade. The first paper yarns, such as "xylodine," "sylvaline," and "licella," were manufactured of paper strips, which were then twisted into yarns by flyers; but they were not nearly so strong as jute and not so durable if exposed to the action of the elements. Though of use for some purposes they were a failure for bags, even with the use of jute warps, as they could not stand moisture.

In recent years, however, M. E. Claviez, of Germany, claims to have solved the problem with the invention of textilose, which is a paper thread reenforced by a core of textile fibers, thus forming what is really a core yarn. The paper used, of which the composition is secret, is very uniform and strong. In the manufacture of this yarn a roll of paper of the desired width is passed though an adhesive material, and then a web of fibrous material, usually cotton fly or napping waste, is run on the glued surface of the paper, and the two are compressed by rollers. Sometimes only one side is coated and sometimes both, in the latter case a different textile material being used for each side. The coated paper passes over drying cylinders and is wound into a roll. The sheet is cut into strips varying in width according to the size of yarn desired, the cutting being effected by parallel shafts carrying conical steel disks. The strips are wound on spools, which are delivered to a flyer spinning frame, similar to that used in the jute trade but without any drawing rollers, and are then twisted and wound on bobbins by means of the flyers. Usually the textilose yarn contains about 10 per cent of cotton waste, which gives it strength and makes it more resistant to moisture.

It is claimed for this yarn that it is cheaper, stronger, and more durable than jute and that textilose fabrics can even be washed, bleached, and colored. It is smoother than jute and less easily affected by acids, and fabrics made of it would be very suitable for wool packs and for sacks for cement, flour, nitrates, etc. Textilose yarns are also being used for upholstery, curtains, carpet backing, etc. The manufacture seems to be a success and is expanding rapidly, as there are now textilose mills in Germany, Austria, Belgium, France, Italy, and the United States. A mill is about to be started in England and others in Spain and Brazil. Textilose has been in use such a short while that it has not yet passed the experimental stage, but it seems to be the most formidable competitor of jute that has yet appeared.

HEMP INDUSTRY IN UNITED KINGDOM.

The term hemp is more loosely applied than any other in fiber terminology. The true hemp, *Cannabis sativa*, is often called soft hemp or European hemp to distinguish it from other fibers, such as manila hemp, aloe fiber, pita, henequen, sisal, Mauritius hemp, and New Zealand hemp. Soft hemp is a stem, or bast, fiber and is obtained by retting, or rotting, in water to dissolve and decompose the gummy matter that binds the fiber to the stem; it is grown from the seed. The hard fibers, on the other hand, are obtained from the leaves of plants and the filaments are covered with succulent pulp that can be removed only by scraping or decortication, as it is called, to leave the useful fiber bare for working; they are usually propagated from cuttings.

IMPORTS OF HEMP FIBERS.

English statistics, which differ from the American, do not separate the imports of soft hemp from those of the various hard fibers, classing all cordage fibers indiscriminately under the general heading of hemp. Imports of this class into the United Kingdom in 1912 were as follows:

Countries.	Tons.	Value.
Dressed and undressed hemp:		
Philippine Islands	83,313	$9,686,676
New Zealand	16,780	1,788,040
British East Indies	14,238	1,453,370
Russia	13,764	2,232,517
Italy	7,881	1,664,786
Germany	3,034	447,874
All other countries	5,609	707,063
Total	144,619	17,980,326
Hemp tow, or codilla:		
Russia	2,662	295,674
New Zealand	2,104	135,308
All other countries	887	89,826
Total	5,653	520,808

The sources from which the imports come show that most of the imports so classed are not true hemp. For instance, that from the Philippine Islands is undoubtedly abaca, or manila hemp; that from New Zealand is New Zealand hemp, or *Phormium tenax;* that from India is mainly Sunn hemp, or *Crotalaria juncea;* while that shown as coming from all other countries would include henequen, sisal, and other fibers. In addition to the foregoing, British statistics show an import of "Hemp (unenumerated vegetable substances applicable to the same use as hemp or flax)," amounting in 1912 to 6,017 tons, valued at $461,991, and this probably includes ramie and similar fibers.

SOURCES OF SOFT HEMP.

Owing to the manner in which the fibers are lumped in the statistics it is impossible to ascertain the amount of soft hemp used in the United Kingdom, but an estimate could be made by taking the imports from Russia, Germany, and Italy. Most of the soft hemp coming from Germany is really Russian hemp shipped through German ports. Russia supplies the great bulk of the soft hemp used in the United Kingdom, but the finest and most valuable grades come from Italy. At one time a fair amount of soft hemp was raised in England in the alluvial districts of Lincolnshire, in Suffolk, and around Holderness, and also some in Ireland, but this industry has now disappeared and the entire supply is imported.

The rope works are located mainly at the seaports, and the hemp imported is landed at London, Leith, Belfast, Liverpool, etc.

The best varieties of hemp are creamy white in color, lustrous, soft, and pliable. When carefully cultivated, prepared, and manufactured the fiber forms a satisfactory substitute for flax and, except for the finer linens, can be employed for the medium grades of nearly all goods made from flax. Some hemp is hackled and used in the linen trade of Belfast in making certain goods, but the total is not large. Some hemp yarns are used in the coarse end of the linen trade of Scotland, either alone or in conjunction with linen yarns. The British Navy still requires a certain amount of hemp canvas and a fair amount is also used in making coal sacks, for which it is very useful because of its strength and greater durability (in England coal is usually delivered in sacks instead of loose from the cart), and for other sacks intended to hold very heavy materials.

SPINDLES WORKING ON HEMP.

The British Board of Trade showed 41,724 spinning spindles, 11,949 doubling spindles, and 516 looms for 1890 and 33,747 spinning spindles, 11,691 doubling spindles, and 88 looms for 1905, working on hemp.

Though some hemp is spun and woven the great bulk of it goes to the rope works and is used for cables, rope, and smaller cordage; in fact, the bulk of the hemp imported is too harsh and coarse for any other use. Soft hemp makes the strongest ropes, those produced from the better grades having a breaking strength superior to that of ordinary manila rope. Tarring is resorted to as a preventive of decay but causes a loss of strength; an untarred rope will hold about a third greater weight. In addition to rope, hemp is used for quite a variety of purposes in the cordage trade, such as making brown hemp yarn for saddlers' and shoemakers' use, seaming twine, ordinary shop twine, and netting twine.

The Belfast Ropework Co. (Ltd.), of Belfast, claims to be the largest rope and cable works in the world and uses considerable soft hemp as well as hard fibers. The works cover an area of 30 acres, using over 5,000 horsepower and employing over 3,000 operatives. The capital of this concern is £500,000, divided into 10,000 preference shares of £10 each and 4,000 common shares of £10 each, 85 per cent of which is paid-up capital.

JUTE INDUSTRY IN INDIA.

WORLD'S CONSUMPTION OF JUTE.

Jute is unique among the textile fibers of the world in that its production is the exclusive monopoly of one country and also in that over half the crop is consumed in factories in the same section of the country in which it is grown.

The growing of jute has always been a monopoly of the northeast section of India; but for a score of years after machinery was adapted to its working, Scotland had a monopoly of its manufacture. To-day India manufactures half of its own crop, and Scotland, though second, manufactures only a little over an eighth of the total. Other large jute-manufacturing countries are Germany, France, United States, Austria-Hungary, Italy, and Russia, and new jute mills are being built and old ones enlarged in many other countries.

Jute is a sacking and wrapping material, and its growth on a commercial scale and its manufacture by machinery came in response to a demand created in the nineteenth century for some material to cover, during their transfer from the field to the market, the rapidly increasing crops of the world. That the utilization of jute was a necessity can be shown by statistics of the increase in crops in the last hundred years and by the fact that the population of the world increased from 500,000,000 in 1800 to 1,600,000,000 in 1900. The increase in the demand for jute, the only material yet produced in the quantity and at the price required, to cover the transport of the crops necessary for the subsistence and clothing of this growing population, foreshadows higher prices and still larger crops of the fiber. Already the demand so tends to outrun the supply that strenuous efforts are being made to find a substitute, either natural or artificial; but jute can be manufactured as well as produced, especially if some of the numerous middlemen are eliminated, at a price so low that it will be a long time before any substitute, however meritorious, can succeed as an active competitor or be more than an auxiliary to eke out an insufficient crop.

TRADE ESTIMATE OF WORLD'S CONSUMPTION.

Elsewhere in this report is shown the production of jute as officially stated by the Indian Government, also the amount taken by various countries, but the latter figures are not conclusive, as considerable jute is transshipped from one country to another. According to the yearly estimates published by W. F. Soutar & Co., jute merchants of Dundee, the jute consumption of the various sections

of the world for certain years has been as follows in bales of 400 pounds:

Consumers.	1874	1884	1894	1904	1912
Indian mills	460,000	900,000	1,500,000	2,900,000	4,400,000
Local Indian	500,000	500,000	500,000	500,000	500,000
Continental Europe	300,000	650,000	1,100,000	1,800,000	2,610,000
United Kingdom	1,000,000	1,200,000	1,200,000	1,200,000	1,345,000
America and other countries	300,000	500,000	500,000	500,000	600,000
Total	2,560,000	3,750,000	4,800,000	6,900,000	9,455,000

The above table shows a marvelous increase in the consumption of jute in India and a very large increase in its use on the Continent, while the growth in its manufacture in the United Kingdom and in all other countries, including the United States, has been small. Not only has the increase in the amount manufactured in India been very large, but the present rate of increase is greater than at almost any other time, and the day does not seem far distant when three-fourths of this crop will be exported from India in the manufactured state. The local Indian consumption, the jute used outside of the mills in India, has for a long time been conventionally estimated as about 500,000 bales, but some authorities now regard this as incorrect and state that not over 300,000 bales are now consumed outside of the mills, as such consumption has been much restricted by the wider use of mill-made goods and by the substitution of corrugated iron for the rough handmade jute goods formerly used in the construction of the primitive native huts.

ESTIMATE OF CONSUMPTION DURING PRESENT YEAR.

W. F. Soutar & Co. estimate that the world's consumption of jute during the season of 1912–13 will be as follows:

Countries.	Bales.	Countries.	Bales.
United Kingdom:		Continent—Continued.	
Scotland	1,300,000	Norway and Sweden	60,000
Ireland	25,000	Netherlands	30,000
England	20,000	Total	2,610,000
Total	1,345,000	America and other countries	600,000
Continent:		India:	
Germany	800,000	Mills	4,400,000
France	620,000	Local	500,000
Austria-Hungary	320,000	Total	4,900,000
Italy	250,000		
Russia	230,000	Grand total	9,455,000
Belgium	150,000		
Spain	150,000		

GROWING AND MARKETING OF JUTE.

The world's jute is grown in the Provinces of Bengal and Assam in northeast India, in the vast delta formed by the Brahmaputra and Ganges Rivers. The Ganges flows southeast through Bengal and empties through numerous mouths into the Bay of Bengal. The Brah-

maputra flows west through Assam until it reaches the borders of Bengal, where it turns southward to join the main channel of the Ganges. Part of the jute crop is grown south of the Ganges, around Calcutta, but the great bulk of the crop is produced to the north and east of this river and in the section drained, and at times inundated, by the Brahmaputra. The crop is mainly grown in the eastern part of Bengal, with a smaller part in the southern part of Bengal and a still smaller part in Assam.

In 1905 Eastern Bengal and Assam were formed into a lieutenant governorship, but the partitioning of the ancient Province of Bengal caused so much dissatisfaction among the natives that in 1913 the two sections of Bengal were once more united and Assam was again made a separate province. The section in which jute is raised in eastern Bengal and Assam is about the same size and has about the same population as the United Kingdom.

STRUCTURE OF PLANT PRODUCING JUTE FIBER.

Jute is the bast fiber of the *Corchorus*. There are two main species, *Corchorus capsularis* and *Corchorus olitorius*, which do not vary greatly in their characteristics, though it is usually considered that the best fiber is produced from the *Corchorus olitorius*. The jute plant is an annual, growing 5 to 10 feet in height, though sometimes reaching 15 feet or more. The stem is straight and smooth and at the bottom is about as thick as one's finger. The commercial fiber lies in the skin which surrounds the inner core, or boon, and which in turn is covered with a pulpy coating. It is a bast, or stem, fiber, like flax and hemp, but is much more easily retted and separated from the boon and the outer skin. Jute fiber is more woody in its nature and has much less strength and tenacity than either flax or hemp, and is one of the most perishable of all fibers, especially if exposed to alternate moisture and drying.

Jute can be cultivated on almost any kind of soil, but its most essential requirement is a hot, damp climate with not too much actual rainfall, especially in the early part of the season. The warm, humid atmosphere of the Brahmaputra and Ganges delta, the alluvial soil formed by the overflow of the large rivers and their numerous tributaries and mouths, and the large supply of cheap native labor form such an ideal combination for the growing of this plant that no other country, nor even any other section of India, has been able to compete. The peasants, or ryots, as they are called, are either Hindu or Mohammedan; a great majority of the inhabitants of Bengal proper are Hindus, but the Mohammedans predominate in Eastern Bengal and Assam.

CULTIVATION OF JUTE.

There are no large plantations, nor is there any systematic cultivation of jute, such as in the growing of cotton; each Hindu ryot cultivates his own small patch with the labor of himself and his family. No attention is paid to seed selection and as a rule no seed is either bought or sold, each ryot obtaining his own supply from a few plants that he leaves to ripen. The preparation of the soil is usually carried on during the winter months, sometimes in the latter but usually in the early part of the year. The ryot breaks the soil with a primi-

tive type of plow, usually made of a tree fork which may or may not be tipped with iron, which is fastened to a yoke resting on the necks of his pair of humped bullocks. Deep plowing is impossible and the cultivator has to plow over a field several times before it is sufficiently broken up. After the clods are broken and pulverized the weeds are collected and burned; the soil is left for a while and then the seeds are sown broadcast. Sowing extends from the middle of March to the end of June, according to the nature and location of the soil, and the crop is harvested any time from the first part of July to the latter part of September, the bulk of the crop being harvested in August and early September. The crop is ready for harvesting as soon as the flowers appear, as the fiber is then in the best condition. The larger part of the crop is grown along the river banks and neighboring sections of a partially submerged country, but the finest fiber is produced on somewhat higher lands having a loamy soil. Some of the better lands farther back from the river have jute rotated with rape, mustard, peas, tobacco, or other crops in a three-year rotation, but the great bulk of the crop is grown without rotation. This fact, together with the lack of seed selection, is stated to be the cause of the deterioration in quality of the fiber that has been increasingly evident in recent years. There is rarely any attempt at soil feeding.

Germination takes place in three or four days after sowing if the soil is sufficiently moist; about 1½ inches of rain per month is enough for the sowing season. The young plants are weeded and thinned out to a distance of 6 or 8 inches apart; if thinned out too much the plant tends to run to branches, while if too closely spaced the stems grow too slender to furnish a remunerative yield. The plants mature in 12 to 15 weeks; the temperature during this growing season varies from 60° to 100° F.

HARVESTING AND RETTING.

The plants are cut with a hand sickle close to the ground, and the long wands, some 5 to 10 feet in length, are tied into bundles and carried to a tank or roadside pool of clear water to be retted. In inundated sections of the country they are sometimes cut and left in the water to ret, while in lower Bengal a tank is easily formed and filled by simply digging a hole in the ground. Some stack the crop for two or three days before retting, but this may cause discoloration of the fiber. In retting, which is necessary to soften the gummy pectose that binds the fibers together, the bundles are laid one on another and covered with straw to prevent the sun from specking the fiber, and they are then weighted down with sod, logs, or other handy material so that all may be under water. The green jute is left to ret (that is, rot) for 10 to 25 days until the fermentation has decomposed the connecting tissues and the fiber has become partially liberated.

When the retting is complete the native enters the pool, and standing in the fetid water up to his waist seizes a handful of stems and beats the thick ends of these with a mallet. He then strips one after another from end to end and thus withdraws the canes entire. Taking up a bundle of the ribbons of fiber he lashes them on the surface of the water, drawing them toward him with a sharp jerking motion that causes the adhering particles of fiber to be brushed off. He

then spreads out the handful of cleaned fiber on the surface of the water and picks off still adhering fiber by hand. The water is wrung out and the clean fiber thrown over a near-by bamboo framework to dry and bleach in the sun for two or three days. The woody boons are also stacked up to dry and are then used for light fencing and for cover in the cultivation of the betel nut.

METHOD OF MARKETING.

India being in the East, in fact, being more "eastern" than the Far East, there is of course no direct trading, and between the ryot producer at one end and the home market at the other there are numerous middlemen, each of whom must have his percentage. First, there are the beparis, or dealers, then the mahajans, or brokers, then the buyers, the balers, and the shippers. Sometimes the last three functions are combined by one firm that bales and ships to Calcutta what its agents buy in the country. The mahajans, or brokers, are mainly Marwari merchants, who come from the Rajputana and who advance money to the bepari dealers or sellers on the condition that the latter bring to the mahajan all the jute they can get from the ryots.

There are numerous native markets, or hâts, scattered over the country. To these the jute is brought by the ryots in boats or carts. Frequently the native brings in a bundle of dried jute on his head and throwing it down in the marketplace squats on it and chews betel nut for half a day maybe while he chaffers with the dealers as to price. The dealers go from one native to another and after considerable trafficking buy up what has been brought in; much of it is bought "sub rosa" by the old Hindu system, in which the buyer and seller hold clasped hands under a fold of a garment and quote, raise, and finally agree on a price by means of the pressure of their fingers, no words being spoken so that the quotation may not become known to the others. The Marwari allows a commission to his dealers and when he has accumulated a sufficient quantity of the raw material it is made up into "drums," or bundles, for shipment on a native boat down the river to the Calcutta market, where it is sold to the European balers and shippers. At the presses, most of which are at Calcutta, the jute is sorted into different grades and the lowest quality called "rejections" put by itself. Separate bales are also made of the thicker and more woody fiber cut off the ends, these latter usually being called "cuttings," except in America where they are known as "jute butts." The merchantable "long jute" fiber is then baled in three or four different grades, each grade being kept separate and having a separate mark. Each shipper has his own series of registered trade-marks for the different grades into which he divides his purchases, and jute is bought abroad on the guarantee of spinning quality thus given. In 1909 and 1910, during sharp fluctuations of the market, such losses were sustained by the middlemen that a considerable number of these grades with their percentages were eliminated, and it seems probable that this experience may result in the producer and the merchant being brought into somewhat more direct relations. Closer relations would be very desirable, as it would result in a stimulation of production by reason of the ryot getting a larger proportion of the shipping price; but in so conservative a

country as India any change is necessarily slow. The primary transaction between the buyer and seller is always in silver rupees, as that is the only money in general use, and this compels the Marwaris to keep a large stock of silver on hand with which to pay for purchases by their agents.

PACKING AND SHIPPING.

Jute is sometimes baled in hand presses worked by a gang of coolies, but that for export is now usually baled in hydraulic presses, which have a pressure of 4 tons to the square inch, and is put up in bales of uniform size measuring 10 cubic feet, and weighing 400 pounds. The bales are bound with roughly twisted ropes of jute but have no covering.

The great jute mart of Hautkola lies along the Hoogly River at the north end of Calcutta. There also are the jute presses and screw houses, conveniently adjacent to the river and to the Port Trust Railway. Immense quantities of jute are received and shipped here every day, especially from August to December. Along the shore at Hautkola may be seen a perfect maze of huge country boats with bamboo frames landing the drums of jute from upcountry and taking on pressed bales for loading on the four-master jute clippers that lie below the bridge some 3 or 4 miles down the river, together with flats and other small river craft. Most of the larger steamers lie up at the docks below the bridge and take their cargo from the vast jute sheds or else direct from the trains run alongside by the Port Trust Railway. The great bulk of the jute exported from India is shipped from Calcutta, with a smaller amount from Chittagong, across the bay.

Most of the local mills are situated on the banks of the Hoogly above Calcutta, and their supply of raw material is largely received by boat, either from Calcutta or upcountry presses.

ACREAGE AND PRODUCTION.

In 1874 the jute crop was only 1,750,000 bales of 400 pounds each, since which time it has increased by about 2,000,000 bales a decade, until it reached the maximum of 9,817,800 bales in the season of 1907–8. Since then it has fluctuated, but with the increasing number of jute mills and the increasing demand for jute products it is probable that before long the crop will be over 10,000,000 bales.

SYSTEM OF CROP ESTIMATES.

The Director of Agriculture in India issues annually two estimates of the jute crop, one about July 15 and the other and final estimate about September 15. The estimate of the jute crop covers 17 districts in which jute is grown, viz, Burdwan, Midnapur, Hoogly, Howrah, all of the districts of the Presidency Division, Champaran, Muzaffarpur, Bhagalpur, Purnea, Darjeeling, the Santhal Parganas, Cuttack, and Balasore. In India everything is reckoned on the basis of the 16 annas that make a rupee. A 16 annas, or normal, jute crop is assumed by the Government to represent an average production of 1,200 pounds, or 3 bales, per acre for every jute-growing district in the Province. From the figures showing the quantity of jute

taken by the local mills and the customs statistics showing the quantity exported, it has become evident that either the estimates are inaccurate or that 3 bales per acre can not be regarded as a correct normal outturn. Steps are now being taken by the Government to verify thoroughly both the district acreages and the average production before the preparation of the next preliminary forecast. It appears certain that the so-called normal figure of 3 bales per acre is under the mark for the leading jute districts. In the absence of any revenue agency the Government's forecasts are based mainly on rough approximate estimates made by district officers, and are more or less conjectural. The district officers obtain information from the subdivisional officers through the agency of the police. As the growing of jute is confined to one section of one country of the world it would seem that a more exact compilation of acreage and production should be possible than in the case of other textiles, which are scattered over various countries; but one has to consider that the section in which jute is grown in India is about as large as the United Kingdom and that it is grown entirely in small patches by uneducated natives.

In addition to the exports and the mill consumption of India considerable quantities of jute are used locally in India. This amount is conventionally estimated at 500,000 bales, but it seems certain that local consumption has been restricted by the wider use of mill-made goods and the substitution of corrugated iron for hand-woven jute cloths in the construction of native huts. The Government's forecasts and final revisions include only the output of Bengal and Assam, but in addition to this probably 100,000 bales, more or less, are raised in outside sections.

GOVERNMENT STATISTICS OF ACREAGE AND PRODUCTION.

According to a pamphlet issued by the Commercial Intelligence Department of India on the "Area and Yield of Certain Principal Crops in India," published in 1912, the revised figures for the acreage and final yield of the jute crop of Bengal and Assam have been as follows:

Years.	Acreage.	Bales.	Years.	Acreage.	Bales.
1897–8	2,151,600	6,839,000	1905–6	3,128,300	8,140,900
1898–9	1,624,400	5,334,000	1906–7	3,482,900	9,206,400
1899–1900	1,961,800	5,412,000	1907–8	3,974,300	9,817,800
1900–1901	2,093,400	6,526,000	1908–9	2,856,700	6,310,800
1901–2	2,263,800	7,438,000	1909–10	2,876,600	7,206,600
1902–3	2,142,700	6,577,000	1910–11	2,937,800	7,932,000
1903–4	2,275,050	7,241,000	1911–12	3,106,400	8,234,700
1904–5	2,899,700	7,400,000			

The 1911–12 figures were made up of 625,100 acres and 1,648,400 bales for Bengal, 2,461,300 acres and 6,543,400 bales for Eastern Bengal and Assam, and 20,000 acres and 42,900 bales for Cooch Bihar State.

TRADE STATISTICS OF PRODUCTION.

Various trade authorities issue figures, based on the mill consumption and the recorded exports, to show the actual outturn of the crop

at the completion of each season. Sometimes these figures are under and sometimes over those estimated by the Government. For instance, for 1911–12 the Government estimated 8,234,700 bales while the Dundee Prices Current and Trade Report states it was 9,460,588, basing this on 4,730,771 bales consumed in India and 4,729,817 bales exported. Other authorities put the total figures slightly different, but it would seem for the last few years that the Government figures have been underestimates.

PRODUCTION IN 1912–13 BY DISTRICTS.

The corrected figures for the crop of 1912–13 are, of course, not yet to hand, but the final forecast made by the Director of Agriculture on September 21, 1912, showed the estimated normal acreage under jute, the estimated acreage under jute this season, and the estimated yield this season (1912–13), together with the date by which harvesting generally commences, for the various districts as follows:

	Normal acreage.	Acreage, 1912–13.	Forecasted outturn.	Date harvesting usually commences.
			Bales.	
Mymensingh	707,700	756,000	2,154,600	Middle of July.
Rangpur	303,000	290,000	783,000	Middle of August.
Tippera	260,000	268,000	763,800	Latter part of June.
Pabna	180,000	220,000	693,000	June and July.
Dacca	145,000	188,000	535,800	July.
Faridpur	125,000	150,000	427,500	Beginning of July.
Jessore	123,500	165,000	544,500	Toward end of August.
Dinajpur	116,500	116,000	315,360	Middle of July.
Bogra	115,000	130,000	312,000	End of July.
Jalpaiguri	106,300	94,800	241,740	Second week of August.
Rajshahi	86,200	80,900	218,430	Middle of July.
24-Parganas	76,600	89,200	294,360	Middle of August.
Nadia	49,400	91,000	259,350	Beginning of August.
Howrah	42,100	25,000	82,500	Middle of July.
Murshidabad	39,800	40,000	114,000	August.
Hoogly	38,400	60,000	198,000	Second week of August.
Maida	33,000	38,000	114,000	Middle of July.
Noakhali	26,000	26,000	74,100	August.
Bakarganj	22,000	29,000	82,650	End of July.
Khulna	18,300	38,100	120,015	Middle of September.
Burdwan	16,500	15,000	47,250	Middle of August.
Midnapore	10,400	11,000	26,400	Do.
Darjeeling	2,900	5,000	10,500	Do.
Chittagong	200	300	855	Last week of August.
Total Bengal	2,643,800	2,927,100	8,413,710	
Assam	533,800	393,950	1,019,665	
Cooch Bihar	48,200	32,750	88,425	
Grand total	3,225,800	3,353,800	9,521,800	

DIFFERENT QUALITIES PRODUCED—SUBSTITUTES.

Mymensingh, a district lying just east of the junction of the Brahmaputra with the Ganges River and directly north of the Dacca section, is the largest producer of jute. The bulk of the jute produced in this district is "Seraganji" jute, which in commerce is usually called Seragunge. The Dacca district, south of Mymensingh, produces "Narainganji" jute, which in commerce is usually known as Naraingunge. "Deora" jute, usually known in commerce as Dowrah, comes mainly from the section around Bakerganj and Faridpur. The jute grown in the districts around Calcutta such as Hoogly, Burdwan, Jessore, and the 24-Parganas is called "Desi"

(meaning local), but in commerce this is usually written Daisee. These are the four main classes in which jute is ordinarily grouped, but there are many minor varieties. The finest grade is said to be "Uttariya," which is a northern Serajgunge jute, and is long, strong, and easily spun, brilliant in color and of a fine texture. In point of softness, however, it does not compare with "Deswal" jute, the next most valuable variety, which is also a Serajgunge jute. Dowrah jute is largely used in rope manufacture and Daisee in the gunny trade.

Jute has been tried in other sections of India, but with little success. The Bombay section was found unsuitable as to both climate and soil. In Madras jute grows well, but it can not be raised at a cost to compete with the more favorable conditions and the larger supply of cheap labor of Bengal. Though shipments of so-called jute are occasionally made from Madras, this is usually Bimlipatam hemp, which is similar to jute in many ways but is not the same. The jute mill at Madras is run mainly with Bimlipatam hemp, and shipments of this fiber are also occasionally made to Dundee. In Burma jute has been tried, but so far without much success. A small amount is raised in sections near Bengal, including Nepal, but the total is negligible. Jute has been tried in Java, Cochin-China, Cuba, and many other countries, but even where the climate and the soil were found favorable the cost of production ran considerably higher than in Bengal, and though jute cultivation in some countries may increase, there is little or no prospect of such production menacing Bengal's practical world monopoly in growing this fiber.

JUTE MANUFACTURE IN INDIA.

Jute was manufactured by hand in Bengal long before the Scotch adapted machinery to its use, in fact, before it had ever been heard of in Europe. It was made into cordage, paper, and cloth, and in the forties gunny sacks were exported to the United States as well as to the Bombay coast and used for transporting sugar and other produce to all parts of the world. This early manufacture by hand was a fairly extensive industry, but of course is dwarfed by comparison with the great amount of jute raised and manufactured since the industry has been stimulated by the application of machinery.

It was not until 1855 that the manufacture of jute by machinery was inaugurated in India, and its start then was rather casual. In 1854 an Englishman named George Ackland, residing in Bengal, became interested in the possibilities of rhea as a competitor of flax and hemp and carried home some of the fiber to see if machinery could be adapted to its use. His scheme did not meet with any encouragement among the machine makers, and when a Dundee jute machinery maker advised him that rhea was too tough and gummy to become a competitor, and added that more practical results could be obtained in India by manufacturing jute in the section where it was raised, and showed him how successfully this was being done in Dundee, he gave up his former plan and ordered a few sets of jute preparing and spinning machinery shipped to Calcutta. The Rishra mill built by him at Rishra, near Serampore, was the first jute mill started in India. The Rishra was started as a spinning mill, but in

1857 added some hand looms. This company did not meet with much success and finally disappeared.

The second jute mill to start in India, that of the Borneo Jute Co., commenced work in 1859 and was the first to introduce power looms. It was afterwards changed to a limited liability company, under the name of the Barnagore Jute Manufacturing Co. (Ltd.), and it to-day ranks as the largest mill in India, having over 2,000 looms in its three factories and employing over 15,000 operatives.

In 1862 the Gourepore mill was started at Naihati, and in 1866 the India Jute Mill was started at Serampore.

Up to 1873 only four jute mills had been started in India, but these proved so promising that there was then a rush to get into the new industry, and in 1873, 1874, and 1875 no fewer than a dozen new mills were put in operation. Another mill was started in 1877, another in 1883, and three more in 1884. The business was overdone and caused so much competition that for a decade there was a lull, and then again a rush of new capital in the latter half of the nineties. The 192 looms of 1859 (with probably some 3,000 spindles) had increased by the end of 1900 to some 14,000 looms and some 300,000 spindles, but it was reserved for the twentieth century to witness the greatest progress in the manufacture of jute in India. Since 1900 the industry has more than doubled and is now increasing faster, relatively as well as absolutely, than ever before.

PROGRESS IN LAST THIRTY YEARS.

The official statistics show the progress of Indian jute mills since 1880 for fiscal years ended March 31, as follows:

Years.	Mills at work.	Nominal capital employed.		Persons employed.	Spindles.	Looms.
		Pounds sterling.	Rupees.			
1879-80	22	1,392,350	12,800,000	27,494	70,840	4,946
1886-87	24	1,557,000	12,900,000	49,015	135,593	6,911
1890-91	26	1,757,000	13,750,000	61,698	162,785	7,804
1895-96	28	1,297,222	27,212,250	78,114	214,679	10,169
1899-1900	34	1,591,358	35,800,000	102,449	295,302	14,119
1900-1	36	1,691,358	40,950,000	111,272	317,348	15,340
1901-2	36	1,741,358	43,508,000	114,795	331,382	16,119
1902-3	38	1,741,358	43,908,000	118,904	352,214	17,189
1903-4	38	2,263,358	40,355,000	123,869	376,718	18,400
1904-5	38	2,283,358	46,680,000	133,162	409,170	19,991
1905-6	39	2,463,358	50,680,000	144,879	453,168	21,986
1906-7	44	2,718,358	54,180,000	166,895	520,504	25,284
1907-8	54	2,893,358	61,880,000	187,771	562,274	27,244
1908-9	56	2,913,358	67,505,000	192,181	607,358	29,525
1909-10	60	2,913 358	71,405,000	204,104	645,862	31,418
1910-11	58	2,913,358	71,305,000	216,390	682,527	33,169

The increase in the capacity of Indian jute mills has been one of the marvels of the manufacturing world, and a larger proportion of the jute crop is now manufactured in the section of the country where it is raised than is the case with any other textile fiber. Not only do the above figures show a great increase, but by the 1st of January, 1913, the looms had increased to some 36,000 and much machinery has been ordered.

In the foregoing statistics part of the capital is given in pounds sterling, this being for companies incorporated in Great Britain, and the remainder in rupees for companies incorporated in India. The capital employed at the end of March, 1911, was £2,913,358 and 71,305,000 rupees, making a total of $37,317,572. This is listed as nominal working capital, as many mills did not return their capitalization. The total is estimated as really having been over $50,000,000 and, of course, has since been considerably increased.

The Indian cotton mills for the year ended March 31, 1911, employed nominal capital to the extent of £636,274 and 214,113,486 rupees, or a total of $72,562,037, but here again there was no accurate returns, as many mills failed to state this. The comparison in other respects is more exact and showed the following:

	Jute mills.	Cotton mills.
Spindles	682,527	6,346,675
Looms	33,169	84,627
Employees:		
Men	141,576	157,629
Women	34,090	39,615
Young persons	19,643	16,223
Children	21,081	17,409
Total	216,390	230,876

RECENT TREND OF INDUSTRY.

Practically all the jute mills in India carry on the complete work, from the raw material to the finished product, but a large number of the cotton mills spin only. The most striking contrast is that jute mills require so many more operatives than cotton mills. The Indian cotton mills with nine times as many spindles and two and a half times as many looms employ only a few more operatives than the jute mills. Jute mills, per spindle or per loom, require many more operatives, and their first cost is much greater than that of cotton mills. Their production is also much greater, for though the jute spindles and looms are run at slower speeds than in the cotton industry the product is much coarser. The Indian cotton industry in the year ended March 31, 1911, turned out 609,927,141 pounds of yarn and 245,814,873 pounds of woven goods, a total of 855,742,014 pounds, requiring some 1,000,000,000 pounds of cotton. The much smaller number of spindles and looms in the Indian jute mills used up some 4,400,000 bales, or 1,760,000,000 pounds, of jute in the same year.

The first jute mill in India, the Rishra, started with Dundee machinery capable of working 8 tons of jute a day. The mills of India in 1913 consume daily over 2,500 tons of jute, which is considerably more than three times as much as that of the Dundee jute mills. In 1850–51 the value of the jute crop to India, as represented by the export of raw material and of some native hand manufactures, was only a little over 41 lakhs of rupees, while the export of raw and manufactured jute in 1912–13 was nearly 50 lakhs (499,217,799 rupees), and the great increase in the amount received by India for

the larger crop has been due in large part to the enhancement in value from manufacturing half of the crop at home.

For some time after machine manufacture was started the Indian mills confined themselves to the coarsest grade of goods, and most of the looms until very recently were classed as sacking looms; but though the Indian mills still make mostly plain cloths, a majority of the looms now used are classed as hessian (burlap) looms. According to the figures of D. R. Wallace, of 3,858 jute looms in India in 1877 there were 2,948 sacking and only 910 hessian, while of 15,213 looms in 1901, 8,613 were sacking and 6,600 hessian. There was then a trend toward the finer and lighter goods, and in 1906 the number of hessian looms passed the sacking looms, and a great majority of the looms installed since and those now being installed are for making hessians. This, of course, makes increasingly sharp competition with Dundee on its staple industry. Calcutta, however, has so far passed Dundee in this industry that the number of operatives actively employed in the Indian jute industry greatly exceeds the entire population of Dundee and its suburbs.

According to the figures of Moran & Co., Calcutta jute brokers, the number of sacking and hessian looms and the reed space actively at work in India on January 1 were as follows:

Reed space in inches.	Number.	Reed space in inches.	Number.
Sacking looms.		*Hessian looms.*—Con.	
32	1,041	49	230
32½	1,606	50	227
33	1,011	51	275
33½, 34	558	52	1,283
36	4,027	52½	3,426
36½	439	53	1,036
37	3,805	53½, 54	656
37½	1,094	56	755
Over 37½	421	56½	101
	14,002	57	146
		57½	111
Hessian looms.		58	145
		58½	588
		60	82
		62½	23
42½, 44	142	64	232
45½	900	Over 64	496
46	1,776		18,610
46½	5,885		
47½, 48	95		

This shows the total jute looms in India on January 1, 1912, as 32,612, which is slightly different from the Government figures; but figures that are obtained from various sources in India will be found to differ according to whether the fiscal, the calendar, or the crop year is considered, not to mention the fact that looms are now increasing so fast that there is a considerable difference sometimes according to the day of the year on which the figures are compiled, and according to whether the figures are for looms actually in operation or also include those being installed.

PRINCIPAL MILLS.

The mills in operation in India January 1, 1913, are given as follows:

Mills.	Looms.	Mills.	Looms.
Albion	340	Howrah	1,550
Alexandra	396	India	1,003
Alipore	48	Kamarhatty	1,278
Alliance	1,002	Kanknarrah	1,467
Anglo-India	1,982	Kelvin	600
Auckland	400	Khardah	1,370
Barnagore	2,040	Kinnison	1,150
Belvedere	400	Lansdowne	870
Briggs	16	Lawrence	432
Budge-Budge	782	Naihati	430
Central	579	National	611
Champdany	494	Northbrook	528
Champdany, Wellington branch	300	Reliance	1,000
Clive	868	Samnuggar	943
Dalhousie	830	Soorah	175
Delta	570	Standard	640
Fort Gloster	1,100	Titaghur	1,718
Fort William	519	Union	525
Ganges	1,298	Union South Mill	650
G ndolpara	354	Victoria	1,053
Gourepore	1,255		
Hastings	810	Total	34,831
Hoogly Upper	455		

Several mills are enlarging and others are being built as fast as machinery can be obtained. It is stated that looms already ordered for installation will run the total number up to 37,316, of which 15,791 are stated to be sacking and 21,525 hessian looms. It is probable that part of the looms ordered can not be obtained from the machine shops in time to start this year, but on the other hand if the present prosperity continues more looms will probably be ordered and the trade expects the increase during 1913 and 1914 to be fully 10 per cent.

The Alipore Jail Jute Mill above mentioned really should not be included among the regular mills, as it does not manufacture for the general market. It was started in 1870 to make wrapper cloth for opium cases and currency bags and it employs only convicts. The Gourepore Co. works an up-to-date oil mill in conjunction with its jute business. The small Briggs mill, now known as the Narcolganga, works on the heavy bagging used for baling American cotton, and the Lansdowne, the Hastings, the Alliance, and the Kinnison also have a few looms that work more or less regularly on this product, the coarsest grade of goods made of jute. The Alliance and the Kinnison, it is stated, are not now (1913) running on such goods, as there is a better and more regular profit on other goods. Bagging for American cotton is made 45 inches wide and generally weighs 2 to $2\frac{1}{2}$ pounds to the linear yard, while the largest regular output of the mills is hessians (burlaps) 40 inches wide and weighing 6 to 14 ounces to the yard; the heaviest regular double-warp bagging or sacking is not much over 24 ounces to the yard.

The Samnuggar, Titaghur, and Victoria are known as the Dundee group of mills, as they were founded with Dundee capital and are managed from a head office located in that city. The other mills were largely built with English capital, some also having native capital, but are managed and financed from their local headquarters.

The Dundee group has been one of the best paying of all, the last dividend for the group being 10 per cent, with a bonus of 5 per cent on the ordinary shares for the year ended December 31, 1912, free of income tax. They are also adding 500 or 600 more looms to their capacity, paying for them out of profits.

According to detailed figures by mills published in the Calcutta Capital, the profits of the Indian mills as a whole amounted to 7,641,162 rupees in 1910, 4,947,888 rupees in 1911, and to 22,069,851 rupees in 1912. The profits for 1913 are expected to be even larger, for though raw jute is much higher the demand for the finished product is such that the mills have been able to maintain and in most cases to increase their margin of profit.

OPERATIVES AND WAGES.

Most of the operatives in Indian jute mills are adult males, while at Dundee the majority are women and girls. Of 216,390 Indian mill workers in 1911, 141,576, or 65.42 per cent, were men; 34,090, or 15.75 per cent, were women; 19,643, or 9.07 per cent, were young persons, 14 to 16 years of age; and 21,081, or 9.74 per cent, children from 9 to 14. Children are allowed to work only half time.

The total number of operatives in Indian jute mills in 1913 is about 250,000 (the number steadily increasing with the rapid addition of new machinery) and the number of European assistants about 500. The European assistants have general oversight of the work and of the machinery, but the active management of the help, arranging shifts, assigning workers to the machines, etc., is carried on by natives called "sirdars," and the checking up of the work done and the paying off of the hands is done by native "babus." It is a common complaint among the workers that the sirdars and babus charge "dasturi" equal to about a week's wages for giving a job to a new man, and also manipulate the payrolls to swell their own profits at the expense of the workers; this system has been found difficult for the Europeans to prevent.

With few exceptions the Indian jute mills are situated on the banks of the River Hoogly, extending a distance of some 40 miles along the river above Calcutta. Each mill is in a large compound on the river bank and is built on the shed principle, having only a ground floor and large doors and windows. Most of the mills have electric lights but there are no humidifiers. A majority of the mills are operated by steam engines, but some mills generate their own electricity for operation.

HOUSING OF EMPLOYEES.

Near the mill are the "coolie lines," or habitations of the workers. Some live in the most insanitary hovels in the bazaars of the towns, but in order to provide for imported labor most of the mills now house a portion of their help in "pucca" brick houses, which they build at a cost of 200 to 250 rupees a room and which they rent at a nominal charge of 12 to 16 annas per room per month. Filtered water is supplied at near-by hydrants and the lines of houses have drains which are regularly flushed. Many natives prefer to live in their own bamboo huts, which are not much more than four posts in the ground, with crosspieces lashed to them at the top, and with sides

and roof of matting or sometimes corrugated iron, and mud-packed floors. The natives usually crowd together and single workers usually board with some other worker who has a female relative living with him to do the cooking; the general rate for board and lodging, where the boarders and the family share one room, is 6 rupees per month. Notwithstanding the crowded conditions under which they usually live and the low standard of living, the workers in the jute mills are usually better off and suffer less from disease than they would in most of their native municipalities, where the sanitary standard is lower.

CHARACTER OF LABOR SUPPLY.

The low standard of living is accompanied by low efficiency, and there are many drawbacks to building up a force of skilled help. There is practically no factory population, such as exists in European countries, comprising a large number of operatives trained from their youth to one particular class of work and dependent for their livelihood upon employment at such work. Most of the workers are men from distant village farms, and they can always earn a living, though on a lower scale, at their hereditary occupation. This fact, together with the increasing demand for labor in an expanding industry, accounts for the independence of the operatives and the lax discipline that usually prevails in the jute mills of Bengal as contrasted with the Bombay cotton mills and jute mills upcountry.

With the expansion of the industry, upcountry men have come in, and the Bengali, who is constitutionally weaker and therefore less capable of standing the long hours, seems to have dropped out. The workers now come from the United Provinces, Orissa, Madras Presidency, Northwest Provinces, and distant districts of Bengal, such as Dacca, Serajgunge, and Behar. The larger portion of the workers seem to be Baharis and United Province natives. Some of the men bring their families with them, being attracted by the fact that there is suitable work for the whole family from 9 years of age up, but a very large number of the men come alone. In such case his home is in the village from which he comes, not in the city in which he works; he regularly remits a portion of his wages to his wife and family at home, and he returns there periodically to look after his affairs and to obtain rest after the strain of factory life. Most of such operatives take two or three months off every year, and during the hot weather in April, May, and June there is always a great scarcity of help in Indian jute mills; not infrequently the production of mills for these months is as much as 25 per cent below normal. Before the introduction of electric lights, in the nineties, the employees usually worked hard during the warm weather and took their vacation at home in the winter months, but they now usually quit work during the hot period. The upcountry man usually stops when he gets ready, for there is always some kind of work for him at his native village, and in most cases he is secured against want by the joint-family system. The position of the operative is strengthened by the fact that the labor supply is inadequate and that there is keen competition among employers to secure a full labor supply; moreover, this competition has been made keener by the growth of new factories. These two main causes—the independence

of the Indian laborer owing to the fact that he possesses other and congenial means of earning a livelihood, and the deficient labor supply—govern the whole situation.

FACTORY DISCIPLINE.

As the Indian operative is not a factory operative pure and simple, he is comparatively unskilled; and as his services are indispensable and hard to get, he is, within wide limits, allowed by his employers to perform the work intrusted to him as he likes. The Indian factory hand is, in general, incapable of prolonged and sustained effort, and he must have time to rest frequently. He is fond of change and likes to wander from one mill to another, and the slightest excuse often leads him to seek a new place of work. The workers are extraordinarily sensitive to any changes being made in their habits or methods of working, even in the smallest trifles; they do their work with ordinary oriental regard to discipline, but they resent any interference with precedent that they regard as uncalled for on the part of the European. Indian workers have been accustomed to regard long hours and low wages as the natural condition of things, but the scarcity of labor and the fact that the workers are practically independent of the mill for a livelihood really make the operatives the masters of the situation to the extent that the mill managers have to allow them to do their work in their own way and must think twice before attempting the slightest change. Strikes are not infrequent, but are rather erratic. For instance, the weavers at one mill struck for shorter hours, and then when they found they could not earn as much as before (they were on piecework), they struck for longer hours. There have been strikes both for and against stopping Saturday afternoon, but as a rule the mills work six full days and do their cleaning and repair work on Sundays. Coolies are employed to clean the preparing and spinning machinery, but the weavers have to clean their own looms. All of the jute mills pay off on Saturday for the previous week.

WORKING HOURS.

With the introduction of the electric light the Indian jute mills worked 15 hours a day, Saturday included, which made a 90-hour week. The mills ran nominally from 5 a. m. to 8 p. m., and some even "cribbed time" openly by working from 4.30 a. m. to 8.30 p. m. None of the mills had any midday rest, there being no stoppage of the machinery from early morning until late at night. The actual time worked by any one operative, however, was not nearly so long. In the preparing and spinning section the operatives were worked in shifts, according to a rather complicated system, so that no one worked over 10 or 11 hours a day. The weavers had to be at the mill the full number of hours the mill ran, but on broad looms there were usually five weavers to four looms; in some cases the extra hand was paid by the mill and in some cases by the weavers, who were given a higher rate for this purpose. With narrow looms the men on four adjoining looms formed themselves into a set, and arranged times of relief among themselves. No weaver worked over 12 hours

actual time, for each spent about 3 hours loafing around the mill compound, smoking, bathing, and preparing and eating his food.

Bengali operatives differ from those of other textile centers, as they will not eat cooked food brought to the mill and always have to take time for cooking. Some operatives who lived an hour or more away from the mill had to get up at 3 o'clock at night to get to the mill by 4.30 or 5 o'clock, and then did not get home until 9 o'clock or later at night. Under such conditions there could be no real family life. Even though it was claimed that no operative actually worked over 12 hours a day the conditions were so bad that in 1907 the Indian Government appointed a commission to inquire into the condition of factory labor in the textile factories. This commission reported in 1908, and as a result of its investigations there was passed March 21, 1911, the Indian factory bill that came into effect July 1, 1912.

Under this law no child can be employed more than 6 hours, no woman more than 11 hours, and no adult male more than 12 hours in any one day, exception being made in certain cases of those in the engine room, repair shop, etc. It requires a stoppage for not less than half an hour at every factory at intervals not exceeding six hours. Women and children are not allowed to commence work before 5.30 a. m. nor to continue work after 7 p. m. The full working week under the act, therefore, is 6 days of 13½ hours, or 81 hours total, instead of the 90 hours that had theretofore prevailed.

Owing to the scarcity of help none of the jute mills has worked at night since 1906, and the new law practically insures that they do not by prohibiting night work of women and children. In the weaving and calender departments a majority of the workers are men, but in batching, preparing, spinning, and winding a very large proportion are women and children. Most of the operatives in the batching, preparing, and spinning rooms are paid by the week, with a bonus for full time. The winders are paid by the box of so many pounds. The weavers are paid by the cut, with a bonus for getting off a certain specified number of cuts a week and an additional bonus for all cuts over the standard requirement. Weavers make 3 to 8 rupees, with an average of about 5 rupees (say, $1.67), a week. Calender men are paid by the week and those in the bag department by the bundle. Engine and mechanic shop workers are paid by the month, as are also babus and other clerks.

WAGE SCALES OF LARGE MILL.

The following is the complete wage list of a large Indian jute mill having over 800 looms in 1909, and though the hours have since been reduced from 90 to 81 a week, the wages have not been changed materially. The wages are stated in rupees, annas, and pies; 12 pies make an anna and 16 annas make a rupee, which is equivalent to 32.443 cents United States currency. The anna is therefore equivalent to approximately 2 cents and the pie to one-sixth of a cent.

Batching, Preparing, and Spinning.

Employees.	Weekly wages.	Bonus.
	R. a. p.	*R. a. p.*
BATCHING.		
Head sirdar	5 0 0	1 0 0
Assistant sirdar	4 0 0	.....
Cutting sirdar	3 0 0	.....
Assistant cutting sirdar	2 8 0	4 0
Weft batching sirdar	2 8 0	8 0
Bale openers	2 8 0	.....
Batchers	1 8 0	2 0
Jute cutters	2 2 0	3 0
Jute carrier coolies	1 10 0	.....
Sweepers	1 10 0	.....
Weighers	1 12 0	.....
Softener feeders	1 12 0	.....
Softener receivers	1 8 0	1 0
Rope and waste cutters	1 14 0	.....
Waste breaker feeders	1 6 0	2 0
Dust shaker coolies	1 10 0	.....
PREPARING.		
Head sirdar	5 8 0	1 0 0
Line sirdars	3 8 0	4 0
Breaker feeders	1 8 0	2 0
Breaker receivers	1 6 0	2 0
Card feeders	1 6 0	2 0
Card receivers	1 6 0	2 0
Hessian breaker coolies	1 10 0	2 0
Sacking breaker coolies	1 10 0	.....

Employees.	Weekly wages.	Bonus.
	R. a. p.	*R. a. p.*
PREPARING—continued.		
Sweepers	1 10 0	.....
Women drawing hands	1 6 0	2 0
Coolie drawing hands	1 10 0	.....
Roving women	1 8 0	2 0
Rover boys	2 0 0	2 0
Shifter boys	1 4 0	.....
Rove coolies	1 10 0	.....
Oilers	2 8 0	4 0
SPINNING.		
Head sirdar	7 0 0	.....
Line sirdars	5 0 0	.....
Shifting sirdars	4 0 0	.....
Hessian warp spinners	2 2 0	.....
Sacking warp spinners	2 4 0	.....
Hessian weft spinners	2 6 0	2 0
Sacking weft spinners	2 10 0	.....
Piecers	1 8 0	.....
Twisters	2 0 0	.....
Shifter boys	1 0 0	2 0
Listing sewers	2 0 0	.....
Oilers	2 8 0	.....
Sweepers	1 4 0	.....
Coolie sirdars	3 0 0	.....
Coolies	1 10 0	.....

Winding and Beaming.

Employees.	Wages.
	R. a. p.
COP WINDING.	
Hessian cop winders.per box (42 lbs.)	7½
Sacking cop winders.....do	4½
Head sirdar.....per week	3 12 0
Assistant sirdar.....do	3 8 0
Cop house coolies.....do	2 4 0
Cop house weighing babu.....do	3 0 0
WARP WINDING.	
Warp winders:	
Hessian yarn (9 bobbins per check), per check	3
Sacking yarn (10 bobbins per check), per check	3
Dyed yarn (7 bobbins per check), per check	3
Head sirdar.....per week	3 8 0
Assistant sirdar.....do	3 0 0
Coolie sirdar.....do	2 4 0
Sweepers.....do	1 4 0
Oilers.....do	2 8 0
Coolies.....do	1 10 0
Bobbin cleaners.....do	1 4 0

Employees.	Wages.
	R. a. p.
WARP WINDING—continued.	
Check distributers.....per week	3 0 0
Reelers.....do	1 14 0
BEAMING.	
Sirdar.....per week	6 0 0
Hessian beamers.....per cut	8
Sacking beamers.....do	7
Dyers.....per week	2 8 0
Dyer coolies.....do	1 14 0
Sweepers.....do	1 4 0
Coolies.....do	1 8 0
WEAVING.	
Cut carriers.....per 100 cuts	8 0
Daily sirdar.....per week	4 0 0
Comb repairer.....do	3 0 0
Oilers.....do	2 8 0
Coolie sirdar.....do	2 4 0
Coolies.....do	1 14 0
Sweepers.....do	1 4 0
Weighing babus.....do	3 0 0
Head cloth examiner.....do	2 2 0
Cloth examiner.....do	2 0 0

Weaving Sirdars.

Employees.	Porter.	Shots per inch.	Width in inches.	Rate per cut.
				Pies.
Head sirdars:				
Hessian	11	12	45	1½
Do	11	12	40	1⅓
Do	9	10	36	1
Sacking				1
Line sirdars:				
Hessian	11	12	45	5½
Do	11	12	40	5½
Do	9	10	36	5
Sugar bags	8	8	28	3¾
Heavy C's	8	9	28	3½
Twill	6	8	26½	3½
K's	6	9	28	3¼
E's	5	8	29	3¼
Pack sheet	7	8	28	3½

Weavers.

Cloth.	Porter.	Shots per inch.	Width in inches.	Rate per cut.	Bonus.	
					Cuts required.	Amount.
				A. p.		*A.*
Plain twills	8	10	33	6 0	12	4
Do	8	10	31	5 9	12	4
Egyptian twill grain sacks	8	9	30	5 9	12	4
Australian corn sacks	8	9	26½	5 0	12	4
Do	8	8	26½	5 0	12	4
Twills	6	8	30	4 6	14	4
No. 2 twills	6	9	26½	4 6	14	4
B twills	6	8	26½	4 3	14	4
Heavy C's	8	8	28	4 6	14	4
Do	8	9	29	4 6	14	4
E's	5	8	29	4 0	15	4
Do	5	8	28	3 9	15	3
Salt bags	6	8	26	4 0	15	3
K's	6	8	28	4 0	15	3
Pack sheet	7	8	28	4 3	14	4
Canvas	12	13	24	5 6	14	4
Twill sugar bags	8	9	28	5 0	12	4
Twills	8	7	30	5 3	12	4
Do	8	8	30	5 6	12	4
Do	8	8	29	5 0	12	4
Do	8	8	28	5 0	12	4
Do	8	8	27	5 0	12	4
Do	8	8	24	4 6	12	4
Do	8	8	22	4 6	12	4
D. W	8	8	29	4 6	14	4
E's	5	8	27	3 9	15	3
Pack sheet	7	9	42⅓	5 6	14	4
Hessians	11	12	45	6 6	12	2
Do	11	12	40	6 6	12	2
Do	10	11	40	6 0	14	2
Do	9	10	40	6 0	14	2
Do	9	10	45	6 0	14	2
Do	9	10	36	6 0	14	2
Do	9	10	50	6 6	14	2
Do	11	10	32	5 0	14	2
Do	11	12	22	5 0	12	2
Do	11	12	30	5 6	12	2
Do	11	12	32	5 6	12	2

Note.—The yarn laid for each of the above-mentioned cloths is 108 yards. An additional bonus of 6 pies is given for every cut woven over and above the number required to earn the initial bonus. The above cloths are woven on 37-inch sacking looms and 46½ and 52½ inch hessian looms. There are 20 broad looms, 60-inch reed space, and on these the weavers are paid 3 pies more for every cut of all fabrics.

Finishing.

Employees.	Weekly wages.		Employees.	Weekly wages.	
	R.	*a.*		*R.*	*a.*
Calender sirdar	3	8	Bag weigher	2	4
Cutting machine sirdar	3	0	Bundle weighing coolies	1	11
Measuring coolies	1	11	Godown sirdars	3	4
Damping coolies	1	11	Godown coolies	1	14
Calender coolies	2	4	Oiler	2	8
Cutting machine coolies	1	14	Markman	3	0
Lapping machine coolies	2	0	Hoop cutter	1	14
Sewing twist coolies	1	11	Sweeper	1	6
Cut bags carrier	1	7	Waste cleaner	1	6
Bag joiners	1	11			

Hemming, Sewing, and Bag Finishing.

Articles.	Size.	Rate per bundle.		Articles.	Size.	Rate per bundle.	
MACHINE HEMMING.				HAND SEWING (ALL HEMMED)—continued.			
	Inches.	*A.*	*p.*		*Inches.*	*A.*	*p.*
Hemmed corn sacks	44 by 26½		3	Corn sacks	44 by 26½	1	1½
Hemmed A twills	44 by 26½		3	B twills	44 by 26½	1	1½
Hemmed B twills	44 by 26½		3	E's	40 by 28		10½
Hemmed E's	40 by 28		2½	Heavy C's	40 by 28		10½
Hemmed salt sacks	45 by 26		2½	E's	44 by 28		10½
Hemmed wheat pockets	36 by 22		4	A twills	36 by 26½	1	1½
MACHINE SEWING.				E's	38 by 28		11½
				Twills	48 by 28	1	3
Hemmed:				Do	58 by 28	1	3
Hessian wheat pockets	36 by 22	1	0	Corn sacks	48 by 26½	1	1½
Grain sacks, tar sewn	60 by 30		9	Wheat bags	36 by 22	1	6
B twills	44 by 26½		9	B twills	40 by 26	1	1½
Corn sacks	44 by 26½		6	Twills	40 by 29	1	1½
B twills	44 by 26½		6	Corn sacks	46 by 26½	1	1½
A twills	44 by 26½		6	Twills	40 by 27	1	1½
E's	40 by 28		6	B twills	37 by 26½	1	1½
Unhemmed:				Twills	40 by 27	1	3
E's	39 by 29		6				
Salt sacks	45 by 26		6	BAG FINISHING.			
Heavy C's	40 by 28		6				
Cotton packs	85 by 45	1	6	Hemmed:			
				Hessian wheat pockets	36 by 22		9
HAND SEWING (ALL HEMMED).				Corn sacks	44 by 26½		6
				A twills	44 by 26½		6
				B twills	44 by 26½		6
Wheat pockets	36 by 22	1	6	E's	40 by 28		4½
Grain sacks	60 by 30	1	3	Salt sacks	45 by 26		4½
B twills, tar sewn	44 by 26½	1	3	Unhemmed: E's	39 by 29		4½
A twills	44 by 26½	1	1½				

Mistries, etc.

Employees.	Rate per month.	Employees.	Rate per month.
ENGINE AND MECHANIC SHOP.	*R. a.*	ENGINE AND MECHANIC SHOP—contd.	*R. a.*
Head viceman	34 8	Shafting oilers	11 6
Viceman	30 0	Do	10 8
Do	23 0	Engine oilers	9 12
Head turnman	27 0		
Turnman	20 0	PREPARING AND SPINNING.	
Do	18 0		
Head joiner	27 0	Preparing department:	
Joiner	25 0	Head viceman	29 0
Do	24 0	Viceman	25 0
Do	16 0	Do	23 0
Craneman	18 0	Do	19 0
Pump man	12 0	Do	18 0
Head rajmistry	15 0	Do	16 0
Rajmistries	13 0	Do	12 0
Head blacksmiths	32 0	Head joiner	28 0
Blacksmiths	28 0	Joiner	24 0
Molder	25 0	Spinning department:	
Head tinsmith	25 0	Head viceman	20 0
Tinsmith	22 0	Viceman	19 0
Head khalasi	14 0	Pin boys	5 0
Khalasies	11 0	Coolies	[1]
Boiler tindel	18 0		
Firemen	12 0	FACTORY.	
Painter	22 0		
Mechanic shop coolies	12 0	Head viceman	30 0
Do	9 12	Viceman	24 0
Electric engine coolie	9 12	Do	21 0
Crane coolie	9 12	Do	19 0
Store coolie	10 0	Do	17 0
Hammermen	10 0	Do	16 0
Boiler men	9 8	Do	14 0
Mechanic shop coolie	9 0	Do	10 0
Mason	9 0	Do	8 0
Coal coolie	9 0	Do	5 0
Molder coolie	9 0	Joiners	22 0
Ash coolie	9 0	Do	14 0
Skylight coolie	7 8	Coolies	9 0
Dispensary coolie	7 0		

[1] 4 annas 6 pies per day.

Mill and Office Clerks.

Clerks.	Rate per month.	Clerks.	Rate per month.
MILL.	*R. a.*	MILL—continued.	*R. a.*
Preparing babu	33 0	Jetty clerk	24 0
Spinning babu	30 0	Doctor	60 0
Winding babu	18 0		
Weaving babu:		OFFICE.	
Hessian looms	[1] 0 4		
Sacking looms	[1] 0 3	Office clerk	70 0
Calender babu	28 0	Do	60 0
Measuring babu	12 0	Do	25 0
Assistant measuring babu	10 0	Do	20 0
Sewing machine babu	14 0	Do	18 0
Hemming machine babu	14 0	Do	16 0
Baling babu	15 0	Draftsman	20 0
Markman babu	12 0	Storekeeper	40 0
Jute godown clerk	15 0	Assistant storekeeper	15 0

[1] Per 100 cuts.

MISCELLANEOUS.

Employees.	Wages.	Employees.	Wages.
OUTDOOR COOLIES.	*R. a. p.*	CREW OF BOATS.	
Coolie sirdar, per week	1 14 0	Cargo boats (9 men each), per month per boat	*R. a. p.* 77 0 0
Coolies, do	1 11 0	Ferryboats (2 men each), per month per boat	18 0 0
Jetty coolie, do	1 10 0		
Iceman, do	1 14 9		
Trolley coolie, do	2 0 0		
Mally (garden) coolies, do	1 11 0		

EXPORT TRADE.

The United Kingdom is the largest purchaser of raw jute from India, and is followed by Germany, the United States, France, Austria-Hungary, and Italy. Australia is usually the largest buyer of gunny bags, and is followed by the United States, Chile, United Kingdom (mainly for transshipment), China, and Java. The United States is by far the largest purchaser of gunny cloth, usually taking some two-thirds of the total export, and is followed by Argentina, and then by Canada and the United Kingdom.

According to the figures of the Indian Office at London the following have been the exports from India of jute and its manufactures for five-year periods and fiscal years ended March 31:

Periods.	Raw jute.	Gunny bags.	Gunny cloth.	Total value.
	Cwt.	*Number.*	*Yards.*	
1880–1884	7,500,000	54,900,000	4,400,000	$4,051,869
1885–1889	8,900,000	77,000,000	15,400,000	5,284,689
1890–1894	10,000,000	111,500,000	41,000,000	9,386,223
1895–1899	12,300,000	171,200,000	182,000,000	16,805,950
1900–1904	12,700,000	206,500,000	427,200,000	26,814,782
1904–5	12,875,312	201,436,286	575,511,587	32,245,956
1905–6	14,480,407	233,326,201	658,671,353	40,385,601
1906–7	15,970,478	257,683,115	696,067,945	50,989,651
1907–8	14,191,597	293,029,510	789,855,788	59,363,930
1908–9	17,879,903	300,906,317	769,798,640	51,054,341
1909–10	14,608,363	364,368,835	940,101,340	55,467,230
1910–11	12,732,460	360,880,236	955,300,737	55,135,733
1911–12	16,203,100	289,784,141	871,484,312	51,930,666
1912–13	17,535,880	311,707,646	1,021,816,869	74,201,497

The record shipment of raw jute was in the year 1908–9 and of gunny bags in 1909–10, but the high record for shipments of cloth was reached with over a billion yards in 1912–13.

EXPORTS OF RAW JUTE, BY COUNTRIES.

The exports of raw jute (including jute, rejections, and cuttings) for the last three fiscal years were taken by the following countries:

Countries.	Quantity.			Value.		
	1911	1912	1913	1911	1912	1913
	Tons.	*Tons.*	*Tons.*			
United Kingdom	234,718	345,762	340,586	$18,907,775	$31,780,740	$35,772,565
Germany	149,066	170,688	180,149	11,719,943	16,500,212	18,591,787
United States	64,714	99,891	124,335	4,995,504	7,415,936	9,199,623
France	72,343	68,413	86,291	5,782,240	6,270,305	8,981,695
Austria-Hungary	40,303	49,809	52,089	2,939,278	4,300,550	5,354,830
Italy	41,474	32,032	42,254	3,222,932	2,937,462	4,483,097
Spain	16,606	23,206	23,829	1,316,023	2,080,777	2,533,669
Russia	8,384	6,971	8,776	667,877	661,958	950,806
Belgium	3,944	5,298	4,774	313,079	489,905	494,001
All other countries	5,071	8,085	13,211	389,987	743,288	1,399,325
Total	636,623	810,155	876,294	50,254,638	73,181,133	87,761,398

In terms of 400-pound bales the exports for the fiscal year ended March 31, 1913, were as follows, together with the percentage taken by each country:

Countries.	Bales.	Per cent.	Countries.	Bales.	Per cent.
United Kingdom	1,907,282	38.88	Spain	133,442	2.72
Germany	1,008,834	20.55	Russia	49,146	1.00
United States	696,276	14.19	Belgium	26,734	.54
France	483,230	9.85	All other countries	73,982	1.51
Austria-Hungary	291,698	5.94			
Italy	236,622	4.82	Total	4,907,246	100.00

The United States ranks after India, the United Kingdom, and Germany as a consumer or manufacturer of raw jute. Nearly half of the raw material imported into the United States is jute butts used for making heavy bagging for covering cotton bales, and the remainder, which is jute proper, is used for making carpet yarns and twines. No burlaps are manufactured in the United States, though the import is considerably over half a billion yards yearly. United States statistics show the imports of jute and of jute butts into the United States during the fiscal year ending June 30, 1913, as follows: Jute, 67,742 tons, valued at $6,913,590; jute butts, 57,084 tons, valued at $2,309,975; total, 124,826 tons, valued at $9,223,565.

EXPORTS BY PRINCIPAL FIRMS.

The export statistics of the Indian Government list all exports under the head of jute, and do not specify long jute, jute butts, and rejections. Such figures are, however, compiled by various trade authorities, but for the trade season, which is different from the fiscal year. The table following was published by a Calcutta jute merchant as showing the shipments of jute, rejections, and cuttings from the ports of Calcutta and Chittagong during the season from July 1,

1912, to May 31, 1913, in bales of 400 pounds each, giving the names of the shippers and also the ports to which shipped:

	Jute.	Rejections.	Cuttings.	Total.
Shipped by—				
Ralli Bros.	981,065	85,411	247,068	1,313,544
Becker Gray & Co.	389,596	335	1,679	391,610
R. Steel & Co. (Ltd.)	302,235	.....	9,154	311,389
Stuart Dott & Co.	303,532	.....	124	303,656
Ernsthausen (Ltd.)	272,604	.....	624	273 228
J. C. Duffus & Co. (Ltd.)	222,675	11,669	30,234	264,578
D. L. Millar & Co.	202,313	4,214	9,123	215,650
George Henderson & Co.	164 252	17,941	10,504	192,697
R. Stanley & Co.	164,854	999	2,398	168 251
Jas. Scott & Sons (Ltd.)	111,780	720	13,504	126,004
MacVicar, Smith & Co. (Ltd.)	119,643	.....	71	119,714
A. Bonnand	115,987	.....	.....	115,987
Petrochino Bros.	107.220	1,609	.....	108,829
E. D. Sassoon & Co.	103,951	.....	.....	103,951
McLeod & Co.	101,023	1,138	1,196	103,357
The Chittagong Co. (Ltd.)	77,309	6,018	10,177	93,504
Cox Bros. (Ltd.)	80,073	.....	5,044	85,117
The Naraingunge Co. (Ltd.)	53,523	12,243	11,429	77,195
A. H. Ghuznavi & Co.	71,727	.....	152	71,879
Ludlow Manufacturing Associates	43,209	856	15,055	59,120
Lyall Marshall & Co.	42,105	1,020	3,774	46,899
Joy Narayan Bros.	37,314	546	749	38,609
J. R. Giridhari Lall	35,889	.....	.....	35,889
Goormuck Roy Surieka	31,420	252	500	32,172
Bird & Co.	26,436	.....	2,197	28,633
S. M. Nagor Mull	24,549	221	1,625	26,395
Nahapiet & Co.	16,301	.....	.....	16,301
G. M. Ram Lal Gonti	13,983	.....	.....	13,983
Jas. Finlay & Co. (Ltd.)	13,648	.....	.....	13,648
Sundry shippers	128,364	184	7,740	136,288
Total	4,358,580	145,376	384,121	4,888,077
Shipped to—				
United Kingdom—				
Dundee	1,205,254	28,924	39,113	1,273.291
Other ports	553,316	25,768	33,539	612,623
Germany	997,371	788	9,982	1,008,141
France	403,298	43,823	3,825	450,946
Austria-Hungary	282,782	1,299	124	284.205
Italy	233,444	974	398	234,816
Spain	128,109	674	2,350	131,133
Other Continental countries	171,164	11,907	714	183,785
American ports	356,393	31,219	290,479	678,091
All other ports	27,449	.....	3,597	31,046
Total	4,358,580	145,376	384,121	4,888,077

Of the long jute, 4,069,591 bales are listed as being shipped from Calcutta and 288,989 from Chittagong; of the rejections, 94,633 from Calcutta and 50,743 from Chittagong; and of the cuttings, 353,262 from Calcutta and 30,859 from Chittagong.

EXPORTS OF GUNNY SACKS BY COUNTRIES.

The exports of gunny sacks from India for the last three fiscal years ended March 31, have been taken by the following countries:

Countries.	Number.			Value.		
	1911	1912	1913	1911	1912	1913
Australia	68,825,585	42,698,765	38,145,380	$6,090,645	$4,388,551	$4,513,250
United States	46,224,570	47,728,700	43,092,700	2,042,199	2,799,201	2,885,147
Chile	41,192,720	32,332,690	36,329,900	2,515,950	2,271,128	2,712,699
United Kingdom	33,427,075	29,831,998	27,434,422	2,386,988	2,219,515	2,700,056
China	10,210,650	14,288,300	21,180,948	879,102	1,380,074	2,389,122
Java	11,533,400	9,774,800	17,025,301	1,118,334	1,040,652	2,076,090
Egypt	12,813,600	9,981,575	13,392,700	1,479,309	1,236,541	1,770,910
West Indies	14,002,900	10,533,950	13,035,600	1,289,830	1,125,247	1,637,099
New Zealand	8,222,950	6,853,950	8,707,050	905,140	935,317	1,260,223
Straits Settlements	10,424,627	8,941,990	8,921,527	1,034,456	790,008	955,383
East Africa	6,687,383	5,891,872	7,580,500	552,525	552,182	815,422
Natal	9,252,675	5,876,250	7,262,350	711,797	552,090	813,487
Indo China	14,408,555	7,490,610	8,813,332	1,174,021	628,371	754,081
Cape Colony	4,771,550	4,435,691	4,685,900	506,714	535,655	700,336
Siam	13,077,000	3,432,518	6,140,420	1,181,103	328,314	652,503
Sandwich Islands	9,556,531	9,868,600	9,023,500	483,261	564,886	636,811
Germany	6,518,500	4,790,340	6,334,150	437,859	361,911	574,165
Turkey:						
Asiatic	6,591,643	4,036,121	4,069,594	612,227	424,941	494,523
European	2,445,250	2,268,700	1,058,800	226,157	237,079	129,349
Belgium	6,508,600	5,840,600	4,176,300	392,193	388,649	387,900
Peru	3,511,400	2,190,800	3,572,500	297,792	198,198	377,086
Mauritius	3,741,400	2,373,200	2,610,400	276,717	186,659	295,347
Japan	2,073,600	2,328,600	2,129,500	153,810	204,683	208,248
All other countries	14,848,072	15,993,521	16,984,972	1,036,523	1,241,706	1,640,274
Total	360,880,236	289,784,141	311,707,646	27,784,652	24,591,558	31,379,528

PRINCIPAL MARKETS FOR BAGS.

The foregoing table affords an interesting contrast with the export of gunny sacks from the United Kingdom. The export of gunny sacks from the United Kingdom for the calendar years 1911 and 1912 amounted to 60,151,968 and 49,248,252, respectively, so it is seen that Calcutta supplies the world with five or six times as many gunny sacks as Dundee. Dundee finds its best market in Argentina, which requires some 10,000,000 wheat bags a year, and in which country India finds it difficult to compete on account of adverse freight rates and connections. Calcutta finds its best market for bags in Australia, as a rule, but for the last two years the United States has taken the largest number, though of a cheaper or smaller kind than that required in Australia, as the value taken by Australia much exceeds the value taken by the United States. The United States is undoubtedly the largest user of jute bags in the world, but the bulk of the bags required are made in that country from imported burlap. It has been estimated that three-fourths of the huge import of burlap into the United States is used for making bags and sacks. Most of the imported bags are used on the Pacific coast, which utilizes some 40,000,000 or more Calcutta bags a year in sacking wheat, oats, and barley. East of the Rockies the American manufacturers of bags control the bulk of the bag trade, the imports from Dundee being comparatively small, and have to furnish bags of all sizes, but the bag requirements of the Pacific coast are mainly for one size of bag, which is known as the "Standard 22 by 32 Calcutta grain bag," and Calcutta, with its 25-cents-a-day coolies can turn out this bag

in such large quantities and ship it to California and Oregon at such prices that American bag factories using imported dutiable burlap can not compete. East of the Rockies grain is usually handled in bulk, but on the Pacific coast most of it is exported, and the vessels that carry grain demand that it be sacked because of the danger of shifting cargo and the sweating of wheat going around the Horn.

Next to Australasia and United States, where the bags are used mainly for sacking grain, India finds its best market for bags in Chile, where they are used for exporting nitrate. Most of those sent to the United Kingdom are for reexport to Argentina, Cuba (which takes some 10,000,000 a year of very fine and heavy sacks for exporting sugar), Brazil, etc., though Brazil itself now weaves and hems most of the bags required for its large crops of coffee, sugar, cocoa, etc. India ships bags to every country in the world, more or less, and Dundee is able to offer active competition practically only in countries where it is favored by better freight facilities. India is yearly furnishing a larger share of the world's requirements of bags as well as burlaps.

EXPORTS OF GUNNY CLOTH, BY COUNTRIES.

The exports of gunny cloth from India for the last three fiscal years ended March 31 have been taken by the following countries:

Countries.	Yards.			Value.		
	1911	1912	1913	1911	1912	1913
United States	664,273,202	595,875,500	663,293,316	$18,076,345	$17,197,804	$25,536,718
Argentina	161,916,000	131,468,500	215,958,127	4,757,335	4,490,533	10,004,074
Canada	28,930,000	33,445,400	50,251,300	847,074	1,087,602	2,225,594
United Kingdom	41,647,472	45,618,350	38,847,225	1,376,935	1,753,830	1,976,400
Australasia	24,746,353	21,124,780	22,881,758	957,138	909,328	1,203,793
Uruguay	8,152,000	10,118,000	9,052,000	248,650	354,537	432,954
China	2,857,000	2,774,500	3,389,750	98,053	113,114	191,219
Germany	5,221,000	9,097,900	2,775,400	154,356	319,013	129,185
All other countries	17,557,710	21,961,382	15,367,993	599,011	853,938	664,065
Total	955,300,737	871,484,312	1,021,816,869	27,114,897	27,079,695	42,364,002

The United States is the main customer for Calcutta burlap, and in the last three years took 69.54 per cent, 68.38 per cent, and 64.91 per cent, respectively, of the total amount exported. As previously noted, the larger portion of this is for making up into bags, but Indian burlap is used in the United States for many other purposes, one of the main uses being to wrap cloth, yarn, etc., when the latter are shipped in bales from the mill to the American consumer or are exported. Dundee burlaps are considered to be more carefully made and usually bring a higher price on the American market than Indian. Next to the United States, India finds its best market for burlaps in Argentina and Canada.

In addition to gunny sacks and gunny cloth Calcutta ships a small amount of jute rope and twine and a trifle of jute yarn, but the total is inconsiderable.

For the fiscal year ended March 31, 1913, the total exports from India of jute gunny bags, gunny cloth, rope, twine, and yarn were valued at $74,201,497, which is the highest figure ever reached.

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